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OVERSIGHT HEARING ON THE SCIENCE AND TECHNOLOGY PROGRAMS OF THE DEPARTMENT OF COMMERCE

Y 4. C 73/7: S. HRG. 104-93

Oversight Hearing on the Science an...

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FOURTH CONGRESS

FIRST SESSION

JANUARY 31, 1995

Printed for the use of the Committee on Commerce, Science, and Transportation

SEP 26 1995

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HEARING ON THE SCIENCE AND TECHNOLOGY PROGRAMS OF THE DEPARTMENT OF COMMERCE

TUESDAY, JANUARY 31, 1995

U.S. SENATE,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The committee met, pursuant to notice, at 10:00 a.m. in room SR–253, Russell Senate Office Building, Hon. Conrad Burns, Chairman of the Subcommittee, presiding.

Staff members assigned to this hearing: Louis C. Whitsett, senior counsel, and Timothy B. Kyger, professional staff member; and Patrick H. Windham, minority senior professional staff member.

OPENING STATEMENT OF SENATOR BURNS

Senator BURNS. Good morning. Before we get started this morning, I want to make a couple of comments.

It has been my privilege to work with Senator Rockefeller the past 4 years on this particular committee, when he was chairing it. And I just want to note his leadership and his dedication to this committee, and the area that it covers, as we start out sort of with an explosion of new leadership around here and the ways to maybe get some things done. But I appreciate his support and his cooperation in the past, and I look forward to working with Senator Rockefeller as we try to form new legislation to cover this particular area.

Also, I want to welcome Secretary Brown this morning. He has exemplified himself very well I think in traveling around the world and representing this country and the technologies, and trying to do what we think is very important to keep this country competitive, and also to keep us No. 1 in the Nation.

I think he shares the same views that I do: that we can out-tech anybody in the world. The problem we have is getting that from the drawing board into the consumers' hands.

So, Mr. Secretary, we welcome you this morning. Most of the leading growth industries in this country are in the advanced technologies, such as telecommunications, computers and biotechnology. If our Nation is to remain competitive, we must continue our leadership in these high-tech areas.

As you know, there is an intense debate in Congress on about how we should do that, and what the Federal Government's role should be. I know the Clinton administration takes the view that

Government should play a major role in funding and supporting private, high-tech ventures, and providing technical assistance to small- and medium-sized businesses.

Between this Advanced Technology Program, the ATP, and the Manufacturing Technology Centers and DOD's Technology Reinvestment Project, the Federal Government is now spending slightly over $1 billion in these activities.

Others, however, believe that programs like ATP are industrial policy, picking winners and losers. They liken the ATP to the European Airbus subsidies that GATT is supposed to discourage. And in view of the marketplace, Government should not determine which startup, high-tech ventures do get financed.

The way I view these NIST programs is that there is a fine line between industrial policy and simply providing a helping hand to a company in need. In my State, I know several cases where small companies with promising ideas just need some early seed money to get the project going, and also to leverage that money against private funds that can be attracted to their activity.

Because I believe these small ventures can use a helping hand, I cosponsored S. 4, the National Competitiveness Act, last year. The bill would have significantly expanded technology grant and assistance programs at NIST. Unfortunately, that died in conference as the Congress closed last year.

However, I continue to believe that programs like ATP are headed in the right direction, in developing a sound public/private partnership to introduce advanced technologies and practices to all tiers of our Nation's manufacturing base.

While I support the NIST programs, I do have some concerns. The first is the dynamic growth in those programs. ATP funding went from $199 million in fiscal year 1994 to $431 million in fiscal year 1995.

Similarly, the Manufacturing Technologies Centers was $30 million, and then that also ballooned to $91 million.

At the time when Congress is struggling to cut spending, to tackle the deficit, further increases in the near future are just absolutely hard to justify. Before these programs are expanded any more, Congress has an obligation to determine whether they are producing any measurable benefit to U.S. industry and to the economy.

I am also troubled by the fact that NIST's helping hand does not seem to fully extend into rural States like my State of Montana or the State of the Chairman of the full committee, in South Dakota.

For instance, while Montana State University did receive NIST support for its work on the green building technologies, no Montana company has ever received an ATP grant or any significant level of assistance from the Manufacturing Technology Centers. And I think it is incumbent on the DOC to ensure that NIST's technological vision includes rural areas.

In addition to NIST, this hearing will also examine the atmospheric programs of the National Oceanic and Atmospheric Administration. They consist of the National Weather Service, the NOAA satellite programs, and the atmospheric research activities.

With respect to the Weather Service, we will look at the status of the $4 billion modernization effort. Agriculture and Montana is agriculture we have a stake in that. And we are eager to get new weather radar and other technologies that will provide earlier and more accurate warnings to storms, tornadoes, and severe weather.

In Montana, the modernization plans call for our seven current weather offices to be consolidated into four high-tech firms. So we want to make sure that these new systems work properly before the old system is completely dismantled.

In that connection, I understand that there are problems with both the Automatic Surface Observing System and the Advanced Weather Interactive Processing System. Hopefully we will hear testimony on the status of these systems and other modernization elements.

Again, I want to welcome Secretary Brown. And I now recognize the Chairman of the full committee, Senator Pressler, from South Dakota, if he has an opening statement.

[The prepared statement of Senator Burns follows:]

PREPARED STATEMENT OF SENATOR BURNS

This hearing will now come to order. First, let me welcome Secretary Brown and our distinguished group of witnesses from the Commerce Department to this hearing of our Science Subcommittee. Mr. Secretary, I know you share my view that it is essential that this Nation maintain its technological edge. Most of the leading growth industries are in advanced technologies like telecommunications, computers, and biotechnology. If our Nation is to remain competitive, we must continue our leadership in these high-tech areas. As you know, there is an intense debate in Congress about how we should do that and what the federal government's role should be. I know the Clinton Administration takes the view that government should play a major role in funding and supporting private high-tech ventures and providing technical assistance to small- and medium-sized businesses. Between NIST's Advanced Technology Program (ATP) and Manufacturing Technology Centers and DOD's Technology Reinvestment Project, the federal government is now spending slightly over $1 billion on these activities. Others, however, believe that programs like ATP are industrial policy picking winners and losers. They liken ATP to the European Airbus subsidies that GATT is suppose to discourage. In their view, the marketplace, not government bureaucrats, should determine which start-up high-tech ventures get financed. The way I view these NIST programs is that there is a fine line between industrial policy and simply providing a "helping hand" to a company in need. In my state, I know of several cases where small companies with promising ideas just need some early-stage "seed money" to get the project going and to attract private capital. Because I believe these small ventures can use a helping hand, I cosponsored S. 4, the National Competitiveness Act, last year. That bill would have significantly expanded the technology grant and assistance programs at NIST. Unfortunately, it died in conference late last Congress. However, I continue to believe that programs like ATP are headed in the right direction in developing a sound public-private partnership to introduce advanced technologies and practices to all tiers of our Nation's manufacturing base. While I support NIST's programs, I do have some concerns. The first is NIST's dramatic growth. ATP funding went from $199 million in FY94 to $431 million in FY95. Similarly, the FY95 funding for the Manufacturing Technology Centers was $91 million, more than three times the FY94 level. At a time when Congress is struggling to cut the deficit, further increases in the near term are hard to justify. Before these programs are expanded any more, Congress has an obligation to determine whether they are producing any measurable benefits for U.S. industry and the economy. I am troubled by the fact that NIST's helping hand does not seem to extend fully to companies in rural states like Montana and South Dakota. For instance, while Montana State University did receive NIST support for its work on "green building" technologies, no Montana company has ever received an ATP grant or any significant level of assistance from the Manufacturing Technology Centers. I think it is incumbent on DOC to ensure that NIST's technological vision include our rural states. In addition to NIST, this hearing will also examine the atmospheric programs of the National Oceanic and Atmospheric Administration (NOAA). They consist of the National Weather Service, the NOAA satellite programs, and the atmospheric research activities. With respect to the weather service, we will look at the status of its $4 billion modernization effort. In a agricultural state like Montana, we are eager to get the new weather radar and other technologies that will provide earlier and more accurate warnings of storms, tornadoes, and other severe weather. In Montana, the modernization plan calls for our seven current weather offices to be consolidated into four high-tech firms. We want to make sure the new system works properly before the old system is dismantled. In that connection, I understand that there are some problems with both the Automated Surface Observing System (ASOS) and the Advanced Weather Interactive Processing System (AWIPS). Hopefully, we will hear testimony on the status of these systems and the other modernization elements. Again, let me thank Secretary Brown and the other witnesses for appearing before the Subcommittee today.

OPENING STATEMENT OF SENATOR PRESSLER

The CHAIRMAN. Thank you very much, Mr. Chairman. Congratulations on the fine leadership you are giving this committee.

Welcome, Secretary Brown, and our other distinguished witnesses. I am pleased that the science subcommittee is holding this oversight hearing on the science and technology programs of the Commerce Department.

As you know, these programs within the jurisdiction of the science subcommittee comprise almost half of Commerce's $4.2 billion budget. Equally significant, these programs touch our lives in some ways some may take for granted.

For example, in my State of South Dakota, our farmers and ranchers depend heavily on fast and accurate weather forecasts and warnings from the National Weather Service. These hearings will allow us to explore several critical policy issues in the science and technology area.

I look forward to hearing testimony on the administration's technology policy, and its strategies for enhancing U.S. industrial competitiveness.

During last year's Senate floor debate on the National Competitiveness Act, there was vigorous discussion on whether NIST technology grant programs represent industrial policy that is, picking winners and losers or whether the Government should provide early stage capital for risky, high-tech ventures.

Regardless of the merit of the NIST programs, it is clear that they alone will not make our Nation more competitive. Any effective competitiveness strategy must also include such elements as appropriate deregulation, tax incentives, antitrust reform, and product liability reform.

Another issue that concerns me is the failure of NIST programs to adequately serve South Dakota and other rural States. My friend from Montana has pointed out that his State is in a similar situation in certain areas.

We, too, would like to be a part of the technology revolution. I note that no South Dakota firm has ever received a grant from NIST's Advanced Technology Program.

Further, none of NIST's Manufacturing Technology Centers currently provide any technical assistance to any company in my State. NIST should serve all of the country, not just several high-tech corridors in the east and the west.

As you may know, many of us in Congress are examining whether certain Government functions can be more cost-effectively performed by the private sector. Such privatization may, in many cases, reduce costs and enhance service to the public. I hope to explore whether any of the Weather Service activities might be possible candidates in this area.

Finally, I note that in 1992, I cosponsored two pieces of legislation that directly impact certain NOAA activities. The first, the Weather Service Modernization Act, requires the Secretary of Commerce to certify there will be no degradation of service before a Weather Service office is closed or consolidated in connection with the $4 billion modernization effort.

In my State, four offices are being consolidated into three, with the office in Huron targeted for closure. We all share a desire to see the new radar and other technologies implemented as soon as they are validated. At the same time, it is in the public interest that the Weather Service accomplish this transition with as little disruption as possible for the employees affected by these changes.

Finally, the second piece of legislation was the Land Remote Sensing Policy Act. That Act sought to give direction and focus to the LANDSAT program, as well as to authorize new private remote sensing ventures.

I am particularly aware of the value of LANDSAT since the EROS data center in Sioux Falls archives the LANDSAT data. For over 20 years, the LANDSAT satellites have provided the Nation with an uninterrupted stream of Earth images. It is important to the agricultural industry, land use planners, scientists, and other LANDSAT users that this data continuity be maintained.

To that end, I am following closely the development of the much-needed replacement LANDSAT 7, the pending litigation involving the LANDSAT contract, and the new management plan for the program.

Let me thank the Chairman of the Subcommittee, Senator Burns, for holding this important hearing. And I look forward to hearing the witnesses' testimony.

Senator BURNS. I thank the Senator from South Dakota.

I recognize at this time the ranking member of this committee. And, as I said awhile ago, I had the good fate of working with Senator Rockefeller over the last 4 years in some capacity ranking and chairman, both on this committee and on travel and tourism. I thank him for his cooperation. Welcome this morning.

[The prepared statement of Senator Pressler follows:]

PREPARED STATEMENT OF SENATOR LARRY PRESSLER

Let me first welcome Secretary Brown and our other distinguished witnesses from the Commerce Department to our Science Subcommittee. I am very pleased that the Science Subcommittee is holding this oversight hearing on the science and technology programs of the Commerce Department today. These programs are among the most important within the Commerce Department. The programs within the jurisdiction of the Science Subcommittee comprise almost half of Commerce's $4.2 billion budget. Equally significant, these programs touch our lives in ways that some may take for granted. For example, in my state of South Dakota, our farmers and ranchers depend heavily on fast and accurate weather forecasts and warnings from the National Weather Service. This hearing will allow us to explore several critical policy issues in the science and technology area. I look forward to hearing testimony on the Administration's technology policy and its strategies for enhancing U.S. industrial competitiveness. During last year's Senate floor debate on the National Competitiveness Act, there was vigorous discussion of whether NIST technology grant programs represent industrial policy (that is, picking winners and losers) or whether the government should provide early-stage capital for risky high-tech ventures. Regardless of the merit of NIST programs, it is clear that they alone will not make our nation more competitive. Any effective competitiveness strategy must also include such elements as: appropriate deregulation, tax incentives, antitrust reform, and product liability reform. Another issue that concerns me is the failure of NIST programs to adequately serve South Dakota and other rural states. We, too, would like to be part of the technological revolution. However, I note that no South Dakota firm has ever received a grant from NIST Advanced Technology Program. Further, none of NIST Manufacturing Technology Centers currently provide any technical assistance to any company in my state. NIST should serve all of the country; not just several high-tech corridors in the East and the West. As you may know, many of us in Congress are examining whether certain government functions can be more cost-effectively performed by the private sector. Such "privatization" may, in many cases, reduce costs and enhance service to the public. I hope to explore whether any of the Weather Service activities might be possible candidates for privatization. Finally, I note that, in 1992, I cosponsored two pieces of legislation that directly impact certain NOAA activities. The first, the Weather Service Modernization Act, requires the Secretary of Commerce to certify there will be no degradation of service before a Weather Service Office is closed or consolidated in connection with the $4 billion modernization effort. In my state, four offices are being consolidated into three, with the office in Huron targeted for closure. We all share a desire to see the new radar and other technologies implemented as soon as they are validated. At the same time, it is in the public interest that the Weather Service accomplish this transition with as little disruption as possible for the employees affected by these changes. The second piece of legislation was the Land Remote Sensing Policy Act. That Act sought to give direction and focus to the Landsat program, as well as authorize new private remote sensing ventures. I am particularly aware of the value of Landsat since the EROS Data Center in Sioux Falls archives the Landsat data. For over 20 years, the Landsat satellites have provided the nation with an uninterrupted stream of Earth images. It is important to the agricultural industry, land use planners, scientists, and other Landsat users that this data continuity be maintained. To that end, I am following closely the development of the much-needed replacement Landsat (Landsat 7); the pending litigation involving the Landsat contract; and the new management plan for the program. Let me thank the Chairman of the Subcommittee, Senator Burns, for holding this important hearing and I look forward to hearing the witnesses' testimony.

OPENING STATEMENT OF SENATOR ROCKEFELLER

Senator ROCKEFELLER. Thank you, Mr. Chairman. Secretary Brown, my apologies. The opening statements are opening statements. They are a time-worn tradition of the Senate.

I begin by reciprocating what my very good friend, Conrad Burns, has said. And this is, in a sense, a very special occasion, because it is the first committee or subcommittee hearing that you have chaired. And I am very proud of that.

I note how well we have worked together in the past. And we have already talked about this. Our States are very similar. We have a lot in common. And I am interested in seeing this subcommittee be successful, and being successful under your leadership.

I also think this is an incredibly important subject. With the changes in leadership caused by the recent election and the push for an even greater restraint on the Federal budget, this subcommittee and the entire Congress have some very, very basic decisions that we have got to make that are going to be a lot harder than what we have made in the years before. And we have got to make them in determining the future role of the Federal Government, and what role should the Federal Government have in science and in technology.

Those are huge decisions to be made.

This committee has responsibility for a key portion of that role; the Department of Commerce science and technology programs are part of that responsibility.

The stakes are absolutely enormous. For many reasons, our companies and workers face unprecedented international competition. With the end of our defense-related priorities of the cold war, more and more other countries are also becoming better manufacturers of products and developing the knowledge and the skilled workers to house higher-tech and higher-wage jobs.

This is the new competition that understandably causes the insecurity that so many Americans feel, even as they may hold jobs. They see downsizing. They hear about what others are doing. They are nervous even as they, themselves, have work.

If the past two decades have taught us anything, it is that the United States of America cannot take economic success for granted. Think back to what happened to many of our industries—steel, autos, semiconductors, computers—we often lost the technological lead. We lost the market share. We lost the jobs.

After wrenching changes and wrenching pain, some of those industries came back. Many fewer workers—auto and steel—but they came back. They came back strong, with fewer workers. But a lot of those industries were lost forever.

To quote directly from a recent statement issued by the Council on Competitiveness, signed by some of America's leaders in business, who are not, to my knowledge, generally shy about saying where they think that the Government should stay out of their pocketbooks and off their back. This Council on Competitiveness said:

> First, science and technology are key to the Nation's economic growth. No program to improve the standard of living and quality of the life of the American people can succeed without ensuring the Nation's continued leadership in science and technology.

And, second, the Government has a central role to play in ensuring that the United States maintains that leadership.

Not my words; their words.

"This principle has long been a subject of bipartisan agreement."

Once again, their words.

The Council then goes on, in the same statement, to remind its readers of its survey that found that most American business, labor and academic leaders believe that the Nation's "greatest competitiveness challenges still lie ahead."

Mr. Chairman, I ask unanimous consent that the full text of what I have just quoted from be made a part of the record.

Senator BURNS. It will be made a part of the record.

[The information referred to follows:]

STATEMENT BY THE COUNCIL ON COMPETITIVENESS (JANUARY 6, 1995)

STATEMENT ON R&D POLICY AND COMPETITIVENESS

As the 104th Congress begins its historic work, efforts to promote research and development (R&D) should be high on the agenda. In fashioning R&D policy, the Congress should keep in mind three fundamental principles.

First, science and technology are key to the nation's economic growth. Economists attribute the unprecedented productivity growth of the United States during the post-World War II period to its strength in research and development—a conclusion borne out by the continuing global competitiveness of such American industries as telecommunications, computers, financial services, pharmaceuticals, chemicals, textiles, aerospace and agriculture. No program to improve the standard of living and quality of life of the American people can succeed without ensuring the nation's continued leadership in science and technology.

Second, the government has a central role to play in ensuring that the United States maintains that leadership. This principle has long been a subject of bipartisan agreement. The federal government has contributed to the nation's success in science and technology in numerous ways since World War II. It has financed about half the nation's research, supporting work in universities, corporations and government laboratories. It has promoted science education, university facilities and advanced telecommunications, putting in place the groundwork for a thriving R&D enterprise. And it has spearheaded work to accomplish national missions, such as exploring space, improving health and maintaining national security, that, in turn, have sparked industrial innovation and increased productivity.

Third, government, industry and academia must work together in an active partnership for science and technology to move forward. Merely continuing 50-year-old R&D policies will not be enough to succeed in an era of global competition. In recent years, Republican and Democratic administrations, working with the Congress, have begun to frame a joint R&D policy for the post-Cold War world based on this notion of cooperation. We need to build on that foundation.

To promote cooperation, government must help create a tax and regulatory environment in which R&D can flourish. The new Congress should ensure that tax laws help increase the availability of long-term, patient capital; that regulations stimulate rather than stifle the R&D efforts of industry and universities; and that intellectual property receives adequate protection.

Government must also see that its own R&D dollars are spent in a way that enhances the long-term competitiveness of the United States. At a time when both federal and corporate budgets are under stress, this is more important than ever. The new Congress should support programs that provide incentives for private partners to pool their R&D capital and expertise to invest in long-term and riskier projects.

The private sector must continue to do its part as well. Industry has begun to focus its R&D on improving manufacturing and market performance. Universities are revamping their curricula and research programs to improve the nation's productivity. These efforts must be sustained and strengthened.

The new willingness of government, industry and academia to work together has already born fruit. The 1994 "Critical Technologies Update" recently published by the Council on Competitiveness showed that the United States has begun to regain its edge in a wide range of technologies. But a Council survey also found that most American business, labor and academic leaders believe that the nation's greatest competitiveness challenges still lie ahead.

The need to respond to this continuing challenge—some might say "threat"—must guide Congressional action in the first 100 days, and beyond. No new agenda, no new program, no new policy will succeed over the long term if it undercuts the ability of the United States to innovate and compete. We urge the Congress to move swiftly to eliminate regulations that unnecessarily encumber R&D and investment in new technology; to enact tax reforms and incentives that stimulate private R&D; and to continue to support federal R&D investment that enhances the nation's competitiveness and encourages cooperation among the government, industry and academia. We stand ready to work with the Congress to develop a comprehensive R&D strategy that includes all three of these elements.

SIGNATORIES TO STATEMENT ON R&D POLICY AND COMPETITIVENESS

Ernest Mario, Co-Chairman and Chief Executive Officer, Alza Corporation;
John R. Stafford, Chairman President and, Chief Executive Officer, American Home Product Corporation;
Richard C. Notebaert, Chairman and Chief Executive Officer, Ameritech Corporation;
Joel Marvil, Chairman and Chief Executive Officer, Ames Rubber Corporation,
Ray Stata, Chairman of the Board and Chief, Executive Officer, Analog Devices, Inc.;
Jack Sheinkman, President, Amalgamated Clothing and Textile Workers Union, AFL-CIO, CLC;
William Archey, President, American Electronics Association;
William V. Muse, President, Auburn University;
Richard M. Rosenberg, Chairman and Chief Executive Officer, BankAmerica Corporation;
John Clendenin, Chairman of the Board, BellSouth Corporation;
Charles A. Heimboid, Jr., President and Chief Executive Officer, Bristol-Myers Squibb Company;
Thomas E. Everhart, President, California Institute of Technology;
Robert Mehrabian, President, Carnegie Mellon University;

Daniel J. Meyer, Chairman and Chief Executive Officer, Cincinnati Milacron, Inc.;
Robert J. Paluck, Chairman and Chief Executive Officer, Convex Computer Corporation;
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John F. Carison, Former Chairman and Chief Executive Officer, Cray Research, Inc.;
Henry B. Schacht, Chairman, Cummins Engine Company, Inc.;
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George M. C. Fisher, Chairman, CEO and President, Eastman Kodak Company;
Sidney A. Taurei, Executive Vice President and President, Pharmaceutical Division, Eli Lilly and Company;
G. Wayne Clough, President, Georgia Institute of Technology;
Alan Magazine, President, Health Industry Manufacturers Association;
Brian D. McLaughlin, President and Chief Executive Officer, Hugo Companies, Inc.;
Louis V. Gerstner, Jr., Chairman and Chief Executive Officer, IBM Corporation;
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Charles M. Vest, President, Massachusetts Institute of Technology;
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Horst K.D. Wallrabe, President, Pharmaceutical Division, Miles Inc.;
T.J. Malone, President and Chief Operating Officer, Milliken & Company;
Lucio A. Noto, Chairman of the Board and Chief Executive Officer, Mobil Corporation;
Gary L. Tooker, Chief Executive Officer, Motorola Inc.;
Joseph R. Hardiman, President, NASDAQ Stock Market;
Jerry Jasinowski, President, National Association of Manufacturers;
John Decaire, President, National Center for Manufacturing Sciences;
Saul K. Fenster, President, New Jersey Institute of Technology;
William Ferguson, Chairman and Chief Executive Officer, NYNEX;
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William Steere, Chairman and CEO, Pfizer Inc.;
Gerald Mossinghoff, President, Pharmaceutical Research and Manufacturers Association;
G. Gilbert Cloyd, Vice President, Pharmaceuticals, The Procter & Gamble Company;
Steven C. Beering, President, Purdue University;
R. Byron Pipes, President, Rensselaer Polytechnic Institute;
Sanford R. Robertson, Chairman, Robertson, Stephens & Company;
Albert J. Simone, President, Rochester Institute of Technology;
Donald R. Beall, Chairman and Chief Executive Officer, Rockwell International;
Daniel B. Hartley, President, Seattle Professional Engineering, Employees Association;
William H. Reed, President, Semiconductor Equipment and Materials International;
Andrew Procassini, President, Semiconductor Industry Association;
Papken S. Der Torossian, Chairman and Chief Executive Officer, Silicon Valley Group, Inc.;
John Young, Chairman, Smart Valley, Inc. and Former Chief Executive Officer, Hewlett-Packard Company;
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Nils Hasselmo, President, University of Minnesota;
Steven B. Sample, President, University of Southern California;
David Ward, Chancellor, University of Wisconsin-Madison;
Joe B. Wyatt, Chancellor, Vanderbilt University;
Paul Allaire, Chairman and Chief Executive Officer, Xerox Corporation;

Bernard V. Vonderschmitt, President, Xilinx Inc.;
[As of January 17, 1995.]

Senator ROCKEFELLER. It is almost human nature in America to figure out how to get through today—that is what a lot of life is about—and not to do much worrying about tomorrow. But I hope this committee will help the new Congress not only worry about, but fight for, the Nation's interests over the longer term, as we look at these programs and their missions.

As industry reminds us, the jobs, the good wages, the sense of hope that Americans are asking for, require that the private and the public sectors work together as we have in the past, as President Reagan and President Bush caused us to become bipartisan about doing.

Abandoning these efforts today—which is on the minds of some—might be the equivalent—I will change that to would be the equivalent—of handing our competitors the economic lead in industry after industry several years from now or further out.

I welcome the questions that Chairman Burns and the rest of the committee want to ask about the programs that are being reviewed today—tough questioning of the Secretary and the Under Secretary—all in order. And in future hearings, I am sure we will have them again.

One central question is whether our limited science and technology resources are being spent in the wisest way possible. Are we taking all the steps necessary to ensure a strong, vibrant economy in the years ahead? Let us evaluate these programs. Let us look at them. Let us look at their contribution, and be honest with each other.

And proposals to eliminate them should also be measured against our national economic needs, not with some abstract or philosophical yardstick that does not do a thing—does not do a whit for real people who live in Glenville, Beckley, Charleston, Welsh, Princeton, and other places in West Virginia, and places in Montana, too.

They are not interested in theory. They want to know what is going to help them keep their jobs or get better jobs.

Over recent years, many of us actually felt that a strong bipartisan consensus had been reached, in fact, in support of science and technology programs that aim at keeping American ahead of the economic curve. We thought this battle was over.

This committee worked closely with both the Reagan and Bush administrations and, only later, the Clinton administration, to create and implement carefully designed, industry-led—to wit, ATP—industry-led programs to help American companies of all sizes speed the development of new ideas and strengthen manufacturing. And we made sure these programs respond to small firms and to businesses in rural areas.

And with the right advice, the right boost, all of this can produce big returns.

These programs are still relatively new, but some are already producing results and real benefit.

In Alta, West Virginia, not famous to most, but beloved by those who live there, for example, Stinson Manufacturing now makes train-engineer chairs for a Philadelphia company, after receiving technical and marketing assistance from the Institute for Advanced Flexible Manufacturing. That Institute matched Stinson's technological capabilities such as they were with the Philadelphia firm's needs for those chairs, taking a market from Sweden, where those jobs were previously produced, and creating 28 new jobs in Alta, West Virginia, in the process. And that is major economic news.

Make no mistake about the stakes involved in this, I say to my colleagues. Other countries are not about to stop their efforts to capture the key technologies and industries and jobs. The decisions we make this year will affect our constituents and all Americans for years to come.

As a Senator of a State bound and determined to win this time—we lost when we mechanized the mines, we lost when we downsized steel, autos and the rest of it—I want to win this time in West Virginia. I want to win in all the States.

And as we go up against even fiercer competition philosophically about what we are talking about, I will say to you, my colleagues, that I am deeply, deeply committed to succeeding. Also I ask that a statement from Senator Hollings be included in the record. He was not able to attend today, but does have these remarks.

[The prepared statement of Senator Hollings follows:]

PREPARED STATEMENT OF SENATOR HOLLINGS

Today, the great issue before this country is its economic future. Ordinary Americans know that prosperity is not automatic. They know, in fact, that the future is uncertain and insecure. They are anxious, and they are angry at a Washington establishment that does place their well-being and future at the top of the agenda. They still want the American dream of a decent life in exchange for hard work, but they are no longer that will achieve it. They live in an era of stagnating wages, relentless competition with low-wage countries, and the risk of losing more American manufacturing jobs, and they worry about their future and that of their children.

Over the past 10 years, Washington has finally started to put together a true competitiveness policy for trade and industry. We have a long a way to go, especially in getting our fiscal house in order and enforcing our trade laws. But we have made some progress, too. One such area is Federal research and technology policy. Here we finally have begun to create private-public technology partnerships for general American industry—following the model that has been so successful over the years for a few key sectors such as agriculture, aircraft, biotechnology, energy, and some electronics.

I want to repeat a basic point: American government support for industrial technology is both long-standing and bipartisan. Since the 19th century, for example, American farmers have had the Land-Grant colleges, the experiment stations, and the extension service. Those valuable programs have provided new basic technologies and practical advice to generations of farmers, helping to make agriculture one of our great American success stories. The fiscal year 1995 appropriation for these agricultural research and extension programs totals $935 million.

In aircraft, the government has worked with industry since the creation of the old National Advisory Committee on Aeronautics in 1915, and today the aeronautics program at NASA continues to work with the U.S. aircraft industry. The fiscal year 1995 NASA aeronautics appropriation is $860 million, plus an additional $400 to start construction of new wind tunnels to test the next generation of commercial aircraft.

And in the health field, does anyone think that the United States would lead in the world in biotechnology if America's combination of brilliant researchers and entrepreneurial companies were not also backed by huge funding from the National Institutes of Health? World leadership in key technology-based industries is not an accident.

What has changed in recent years is not the time-honored model of government helping to develop new critical technologies in important sectors. What has changed is the need to apply that model to sectors other than a few areas such as agriculture, aircraft, and biotechnology. The United States is no longer automatically the world's leader in general manufacturing industries. Starting in the 1970's, other countries challenged the American lead machine tools, electronics, advanced materials, and many other areas. International competition is now intense, and other nations are investing relentlessly to be world leaders in these sectors. We ignore these trends are our peril.

In 1988, Congress took the step of creating small but valuable programs to work with general industry and manufacturing. Building on the old National Bureau of Standards, we created the National Institute of Standards and Technology (NIST) and two important new programs. First, we created manufacturing extension centers to help the Nation's 360,000 small manufacturers. These are locally run and cost-shared with the states and industry. We also created the Advanced Technology Program (ATP) to support industry-led projects in a wide range of sectors to develop new basic technologies that companies have a hard time financing on their own in this era of relentless Wall Street pressures to focus on the short-term. These technologies offer the potential to create entire new industries and large numbers of jobs—jobs in America rather than overseas. Total fiscal year 1995 funding for the extension centers and ATP totals $523 million—less than 1 percent of total Federal R&D spending. In contrast, Germany spends 14 percent of its government research budget on analogous technology programs to help general industry and manufacturing.

These programs at the Commerce enjoy an excellent reputation. For example, a recent survey by the Industrial Research Institute found that its corporate members rated the ATP as the government's most useful research program. Yet now the "Contract with America" proposes to eliminate the ATP, and some House Republicans propose to abolish the manufacturing extension centers as well. They propose tax cuts as an alternative, but of course that is a false choice. Other countries will use all their available tools—including both tax incentives and technology programs—to give their companies the edge in international competition.

This Congress will cut Federal spending. But in looking at any specific proposed cut, I will apply a simple but powerful test: will a specific cut help or hurt long-term American prosperity? Will this cut, as opposed to others, make this country richer or power? By this simple test, cutting the high-priority research programs that American industry finds most useful is nonsense. In a time of budget cuts, we must keep what is most useful and eliminate items of lower priority.

We often hear the complaint that the government should not "pick winners and losers." Well, in the Advanced Technology Program industry, not government, chooses which projects to propose, and companies back this up with their own matching funds. But the winners-and-losers argument can be seen in a larger context. With other countries actively seeking the lead in key new technologies and industries, the United States as a country has a choice. Either it can go all out, with industry and government working together to make our country a winner in the tough world economy of the 21st century. Or by limiting ourselves to half-measures, we can guarantee that America and its citizens are the long-term losers. It's our choice. It is the choice before this Congress.

The hearing today gives us an opportunity to review industry government technology partnerships such as the ATP and the manufacturing centers. Today we can ask the hard questions and discuss our priorities for the Federal research budget. I hope the Congress will make the right decision, and will cast its lot with those research programs that will make the most difference to our Nation's economic future.

I thank the chair for substantial forbearance.

Senator BURNS. Thank you, Senator Rockefeller.

And now, welcome to our friend from Alaska, Senator Stevens.

Senator STEVENS. I have no statement, and I am anxious to hear my friend, Secretary Brown.

Senator BURNS. Mr. Secretary, welcome. I think this is a record. We got through the opening statements in 20 minutes. We hope that becomes a standard from now on.

We thank you for coming this morning, and we look forward to your testimony.

STATEMENT OF HON. RONALD H. BROWN, SECRETARY OF COMMERCE, DEPARTMENT OF COMMERCE

Secretary BROWN. Thank you very much, Mr. Chairman, Mr. Rockefeller, Senator Pressler, and Senator Stevens. I am indeed honored to be here at what is an historic hearing—historic because, Senator Rockefeller pointed out, the first one for the good Senator from Montana to chair.

I would like to begin, Mr. Chairman, by commending you for holding this hearing and for affording me and my technology team—Dr. Mary Good, our Under Secretary for Technology; Dr. Jim Baker, our Secretary for Oceans and Atmosphere; and our Director of the National Institute of Standards and Technology, Arati Prabhakar—a great team that we have put together at the Commerce Department to foster our technology initiatives, to give us the opportunity to come here and testify before you this morning about civilian technology, the activities we are involved in at the Department of Commerce, and in the administration.

I would also like to thank you, Mr. Chairman, for your support of S. 4 during the 103rd Congress. It was important legislation. I hope we can get to it again. There is nothing more important than demonstrating our commitment to productivity and to competitiveness to assure that we not only compete, but win in this global, highly competitive economic environment.

The efforts that we are engaged in, we believe, are a critical part of our administration's vision for the future—a vision of a United States economy sustained by growth, creating economic opportunities for all of the American people, a place where dynamic American businesses and highly skilled American workers can use advanced technologies to produce the goods and the services that consumers will demand, both here at home and all around the world.

To reach that vision requires that we employ each of four ingredient of national economic growth: investment, a skilled work force, open markets, and, of course, innovation. It is innovation that we are going to be focusing on this morning.

Together, they form the basic equation of international competitiveness.

There has been a lot of talk recently that the United States' competitiveness problems are behind us. And although we are very pleased by the recent reports indicating that we are the most competitive nation in the world, we cannot sit on our laurels.

I would like to believe that under the leadership of President Clinton and Vice President Gore, we have made the tough decisions, and have begun to get our fiscal house in order. We have reduced the deficit for the third straight year—the first time since the Truman administration—and we have reduced the size of the Federal work force to the smallest level since President John F. Kennedy was President of the United States.

We have done all this while making Government more responsive and, I believe, more effective.

What should be up—that is, economic growth and jobs and consumer confidence—are up. And what should be down—the deficit, unemployment and inflation—are down.

But as we proceed through this hearing and others, I want to warn that a short-term economic revitalization and strong economic recovery still leaves us with a need to resolve longer-term structural economic problems. We still, in other words, have our work cut out for us in many areas.

Trends in research and development spending and our merchandize trade balance, for example, are still very troubling. While companies have restructured and reduced waste and improved efficiency and begun to invest in plants and equipment, they have a long way to go to make up for the years that their investment has lagged behind the competition.

And as you well know, many of our people, many smaller companies, and many communities around America have yet to feel the benefits of our national economic recovery. But I am not here this morning to tell you that the sky is falling, because it is not. Our economy is on track. The fundamentals look good. We have a strong and vibrant economy by any objective measure. We are clearly on the right track.

We are working well with the private sector, trying to redefine a relationship, trying to build a new partnership between the public and private sectors in America. We are working to boost investment, and not to crowd it out. We are working to provide economic opportunities and to expand the economic pie for all of the American people. We are working to reduce barriers to competition today and tomorrow.

My principal emphasis this morning, as it should be, will be on the importance of stimulating innovation. The close connection between innovation and economic performance has been reconfirmed by new research by my own Department's Economics and Statistics Administration, which we released just last month.

That report found that firms using advanced technologies are more productive, that they pay higher wages, that they offer more secure jobs, and that they increase employment more rapidly than firms which do not.

The chart to my right illustrates the vital role that industry/government partnership and the leveraging activities play in the progress of science and technology.

United States industry, as the chart points out, invests more than 90 percent of the $84 billion it spends annually on research and development, on short-term product development, and applied research. In today's fiercely competitive and global marketplace in which product life cycles are measured in months, industry's focus must in fact be on short-term product and process innovations.

On the other hand, the U.S. Government makes longer-term investments in basic science and mission-oriented R&D. That is where the $70 billion spent by the U.S. Government chiefly goes, such as my own Department's NIST laboratories and our NOAA basic research.

As the next chart shows, 58 percent of the Federal Government's R&D funding relates to the mission of defense. And most of the rest of basic and mission-oriented research really is focused on the health care area of the economic pie.

But that still leaves a major gap. As the first chart showed, industry/government partnership and leverage activities are less than 2 percent of Government-funded R&D. Like any portfolio, I might suggest, the mix of R&D activities must reflect a balance between long-term and short-term goals.

While research and applied science is a vital component of our innovation portfolio, and while short-term commercialization is necessary, it is clearly not enough. We have learned over the past 20 years that all too often United States' discoveries of basic knowledge were better exploited by other countries that were better able to develop applicable technologies and transform them into competitive products and services.

The marketplace alone will not invest sufficient resources into mid- and longer-term, broad-based technology development needed by the private sector to fully exploit this basic knowledge that we in America develop.

Today we seek—and I believe that we need—a different model—one which focuses explicitly on civilian industrial technology and better connects the Federal basic research mission to the real-world, private sector commercialization—one in which private/public partnerships spur private sector investment in high-risk, long-term innovations with broad-based economic impact.

That is the role of our industry-led technology partnerships: to provide the linkage between basic science and private sector commercialization and use. That is the gap between the $84 billion and the $70 billion.

How do we make sure that gap is filled in? How do we make sure that those opportunities do not fall between the cracks? For that little bit, that 2 percent of total of R&D that Senator Rockefeller referred to, we have got to make some policy decisions. We have got to create a set principles by which to establish some priorities. And that is exactly what we are trying to do.

When you consider that these funds are highly leveraged by industry investment and promise widespread economic benefit to our Nation, it would be a shame to eliminate this critical fraction of a percent which helps build the industrial base we need to support our national and our economic security.

Indeed, to do so, I believe, Mr. Chairman, and member of the committee, would be tantamount to unilateral disarmament in the global marketplace. Consider the R&D expenditures of our major trading partners, which are illustrated on the next chart. As a percentage of GDP, we lag behind Germany and Japan and are roughly on a par with France and the United Kingdom. That is not good enough for America.

Our ATP program helps address our persistent shortfall in investment in long-term, high-risk enabling technologies.

By sharing the cost of research, the ATP program reduces the risk for private businesses, thus allowing them to conduct R&D that might otherwise be delay or not be conducted at all.

Through a rigorous, merit-based review, the ATP program ensures that funded research has both technological and commercial potential. And with a bottom-up, private-sector-driven approach, the ATP program maintains private sector priorities, not Government fiat. It maintains them as the driving force for technological achievement and focus.

The first 4 years of the ATP program have shown small businesses in particular to be the eager participant. As the next chart shows, of the awards made since 1990, roughly half have been to individual small businesses or joint ventures led by small businesses.

Accuwave, a small California company, is really a good example of what we are talking about. In 1992, we announced an award of just under $2 million to Accuwave. The company was formed to exploit an intriguing new technology that could allow existing fiber optic cables to carry as many as 10 times the current number of channels. The impact on the telecommunications industry could be enormous.

Let us consider this project, if we might, Mr. Chairman, for just a moment. Can a small entrepreneurial company benefit from the ATP?

Mr. Chairman, when Accuwave submitted its proposal, the company was only 2 years old. It succeeded in a rigorous competition that funded only about 15 percent of the applicants that year. And it succeeded on the strengths of its technology and its plan for eventually commercializing its work.

The question is: Are we spending tax dollars on product development?

Mr. Chairman, I can say this as many times as anyone wishes to hear it. The ATP program does not pay for product development. We work in areas where there are important, risky technical issues that must be resolved before a company can even think about product development. That is true for Accuwave, which did its early work in related, but quite different, fields.

Are we substituting tax dollars for private capital?

Mr. Chairman, there was no private capital for this. Accuwave was a small, new firm with 10 people and with no track record. It did not have the in-house resources to do the project themselves. And without the ATP, it would not have had external funding either. The risks were just too high.

I know there is a tendency sometimes to say, "Well, just go out into the capital marketplace. Just go find an investment banker. Just go find a venture capitalist."

Mr. Chairman, I think we all know that venture capitalists look to opportunities where product development is right around the corner, where they can get something in the marketplace next month or next year, where they can feel or touch or smell something.

The fact is that most of these projects—all of them—funded by the ATP program are programs that there is no venture capital for.

On the other hand, with the ATP, Accuwave has already made important progress. I hold in my hand a device called a wavelength locker. Its purpose is to stabilize and control communications lasers and to improve network performance.

This little module that I have in my hand, designed for easy use on a circuit board, replaces a tabletop full of optical equipment. And it is based on an ATP-sponsored research program.

It is unique in the field. It could be the forerunner of a whole family of new, world-class products, with huge commercial potential. It is a technology that would not be entering the market now without the assistance of the ATP program to overcome early technical hurdles.

That is what the Advanced Technology Program is really all about.

Stimulating the development of innovative technologies is only half of the equation. The other half—getting new and existing products to market in a timely, cost-effective, competitive way—is also critical if American firms are to succeed in the global marketplace.

America's 370,000 small- and medium-sized manufacturers will have easy access to modern manufacturing technologies and production techniques and best practices through the Manufacturing Extension Partnership National System, which was mentioned in a number of the opening statements.

That is illustrated on the next chart.

These Manufacturing Extension Centers are industry-driven. They are responsive. And they are focused on positive, bottom-line impacts.

In other words, Mr. Chairman, how do we get new technology in the hands of small- and medium-sized businesses so they can be more productive and more competitive, so they can get into the export marketplace, so they can sell their goods and products and services, so they can create economic growth and jobs here at home?

Mr. Chairman, you can see that we are serious about reaching out to small- and medium-sized businesses, to help make them more productive and more competitive, and to put new technology—not only high technology, but all technology—into the hands of entrepreneurs, so that they can have the tools that they need to create economic growth and to create jobs—a network that, when completed, will reach businesses in all parts of the Nation, urban and suburban, and rural as well.

And, Mr. Chairman, and members of the committee, if my testimony today has emphasized anything at all, it is this: We live in an increasingly competitive global economy in which all aspects of economic competitiveness are integrally connected. The Department of Commerce, I might suggest, is where these connections are made.

Some have suggested that we need to create a new, so-called Department of the Future. I respectfully submit that what we need—what America's businesses and communities and workers need—is a Department focused on economic growth and export growth, focused on technological innovation, focused on sustainable development, focused on economic development, and focused on sound economic analysis.

The Department of the Future, on other words, is today's Department of Commerce.

Within our bureaus, we work better in ever respect, because we are confronted every day with the intersection of trade, technology, the environment, and economic development. That intersection is where the future of the United States economy is being fashioned. Every day, in every way, by entrepreneurs who force our future, one deal, one contact, one transaction at a time.

My Department, Mr. Chairman, works with them every day, we believe, to our mutual benefit and the benefit of our country.

Thank you very much, Mr. Chairman, for the opportunity to appear before you today.

[The prepared statement of Secretary Brown follows:]

PREPARED STATEMENT OF SECRETARY RON BROWN

Mr. Chairman, Mr. Rockefeller, and members of the Committee.

Let me begin, Mr. Chairman, by commending you for holding this hearing and affording me the opportunity to talk about the Department of Commerce's technology programs.

Today, we are harvesting the results of research and technology investments bade ten, twenty and thirty years ago. These are stories of remarkable success, due to the foresight of our predecessors who recognized that support of research and development and technology deployment is a fundamental mechanism for achieving national missions and a stronger economy.

Our vision for the future is one of a United States economy sustained by growth, creating economic opportunities for all Americans. A place where U.S. businesses—large.and small—use globally competitive advanced processes to produce the goods and services that world consumers will demand—success stories of the 21st Century built on the farsighted actions of today and tomorrow.

We now have the opportunity to begin these stories. But to do so requires that we understand the nature of our economy and the lessons of our past support for science and technology efforts.

I. New Economic Realities

Mr. Chairman, we are facing a time of great economic change. We have witnessed the demise of communism as freedom and democracy fill new nations with hope and opportunity. I have visited these economies in transition—South Africa, the Middle-East, Russia—places where a new economic future is being built.

At the same time, a new battlefield has emerged in the form of a global marketplace, and able competitors from around the world are fighting for a share. Technology is racing ahead at a breath-taking pace, with each advance more staggering than the last.

And, in the wake of these forces, the way we live, learn, work, and play is being forever transformed. Each of these changes alone would be revolutionary but, together, they have produced results that are deeply felt by Americans in all ways of life.

These changes create uncertainties—and opportunities. We must confront the basic challenge of our time: Will we try to hold change at arms-length or will we take advantage of the opportunities that change will bring? And we must answer that challenge with this strategy: to empower Americans with the tools that they need to take advantage of economic opportunity.

We must work as a nation—with our businesses, with our workers, with our communities—to ensure that the United States remains the locus of dynamic firms, strong communities and skilled workers. In today's economy, it is not just companies, it is also nations that compete.

Consider the ingredients of sustainable national economic growth: investment, a skilled workforce, open markets, and, most importantly, innovation. Together, they form the basic equation of international competitiveness.

Today's hearing will focus primarily on the Department's technology programs—the Advanced Technology Program, the Manufacturing Extension Partnership, the Telecommunications Information Infrastructure Assistance Program, and the lab programs at the National Institute of Standards and Technology (NIST) and the National Oceanic and Atmospheric Administration (NOAA). But I want to make the point up front—for it is important to consider that all the activities of the Department—from trade promotion to weather prediction to calibrations services form an integrated, highly leveraged package that makes our Department the Department of the Future.

And, Mr. Chairman, our programs are smart programs—programs that lubricate the free market engine. Programs that boost investment, not crowd it out. Programs that provide economic opportunities and expand the economic pie for all Americans. Programs that reduce barriers to competition today and tomorrow, not raise them.

I also want to make it clear that we are constantly thinking about the future. There has been a lot of talk recently that the United States' competitiveness problems are behind us. Under the leadership of President Clinton and Vice President Gore, we have made tough decisions and have begun to get our fiscal house in order. We have reduced the deficit for the third straight year—the first time since the Truman Administration—and we have reduced the size of the federal workforce to the smallest levels since—President Kennedy's time, all the while making government more responsive and more effective. What should be up—economic growth, jobs, and consumer confidence—are up. What should be down—the deficit, unemployment, and inflation—are down.

But I want to warn us against confusing short term economic revitalization and strong economic growth with the resolution of longer-term, structural problems. We still have our work cut out in a number of areas. Trends in R&D spending and our merchandise trade balance, for example, are still troubling. And while companies have restructured, reduced waste and improved efficiency, and begun increasing investment in plant and equipment, they have a long way to go to catch up for the years they have lagged behind their competitors. And, many smaller companies and urban and rural communities have yet to feel the benefits of our national economic performance.

But I am not here this morning to tell you that the sky is falling. It is not. We have a strong and vibrant economy. I'm here to tell you that we are headed on the right track and to convince you that now is not the time to change our course.

My principal emphasis will be on the importance of stimulating innovation, which I will discuss in detail. It is important; however, that we bear in mind our responsibility to further the national interest in each of the four ingredients of economic growth.

First, investment. Private investment drives competition and growth. It is critical to support private investment through sustained progress on budget deficits. That is why President Clinton fought so hard—and so successfully—for a deficit reduction package that got government out of businesses' way in our capital markets. The result: since the end of 1992, business investment in plant and equipment has increased at an annual rate of 14%.

Private investment provides a lifeline for those dynamic firms that spur technological innovation, create jobs and foster economic growth. For example, two-thirds of the manufacturing jobs created each year originate in plants that grow by 25 percent or more in that year alone. The basic lesson is clear: Our economy is only as strong as the best firms that populate it.

Second, a skilled workforce. For firms to succeed in the economy, however, it is necessary that we have an educated, well-trained workforce. Traditional economists might view knowledge and labor as two distinct sources of economic growth but, in today's information-based economy, the prowess of our workforce is increasingly bound to the success of education and training. We cannot capitalize on advances in science and technology without a workforce able to harness these innovations. That is why the President's middle class tax cut is focused on education and training.

Third, open markets—both foreign and domestic. As you know, Mr. Chairman, opening foreign markets to the effective participation of U.S. businesses has been a priority of this Administration, of the Department of Commerce and of my own activities. Of course, our leadership in science and technology will only bear fruit if we have markets open to our innovative products.

The passage of the North American Free Trade-Agreement (NAFTA) and of the Uruguay Round GATT agreement will create enormous potential for world trade and economic growth. NAFTA has begun to take economic hold. U.S. exports to Mexico shot up 23 percent in the first 10 months of 1994 compared to the same period a year earlier. Mexico and Canada alone accounted for nearly half the growth of global U.S. exports during this, period. When fully implemented, GATT should add as much as $100 billion to $200 billion to the U.S. gross domestic product annually; raise total U.S. employment by hundreds of thousands of jobs; save individual U.S. consumers hundreds of dollars annually in lower costs of food and other important items; and boost real wages and living standards in the U.S. and around the world.

The framework of open markets is, however, not enough. Exploiting those opportunities is just as critical. That is why the inter-agency Trade Promotion Coordinating Committee, which I chair, issued the first National Export Strategy in 1993 and refined that strategy in a report issued last October. The purpose of the National Export Strategy is clear: to help U.S. companies—small, medium and large—realize their full export potential.

Boosting U.S. exports is a core mission of the Department of Commerce. Our advocacy, and that of President Clinton, on behalf of U.S. businesses competing for foreign government procurements is beginning to bear fruit:

- in Saudi Arabia's intent to purchase aircraft from the Boeing Co. and McDonnell Douglas Corp., valued at $6 billion, and that country's $4 billion contract for telecommunications network modernization awarded to AT&T;
- in Brazil's award of the $1.5 billion SWAM rain-forest protection contract to the Raytheon Company, a defense contractor moving into civilian production;
- in China's agreement to purchase $6 billion worth of goods and services from U.S. companies, including two Westinghouse contracts worth $450 million, an Ap-

plied Energy Services contract worth $1.5 billion, and an AT&T agreement valued at $500 million to provide telecommunications equipment;

- and, in India's more than 25 deals worth over $7 billion with U.S. companies such as Tandem Computers, Hughes Network Systems, Inc., and United International Holdings, Inc., and the establishment of the U.S.-India Commercial Alliance.

Of course, markets here at home must be dynamic and competitive as well. We live in a global era in which success at home will often translate into success abroad but in which, conversely, failure to achieve success at home will leave domestic firms at risk in the United States and at a competitive disadvantage abroad. That is why, for example, the Administration has placed such emphasis on the passage of telecommunications legislation that will deregulate and open new markets.

We look forward to working with the 104th Congress to reform our 60-year old communications law to remove legal and regulatory impediments to competition while still safeguarding the public interest.

The importance of this effort is too obvious to ignore. Last year the Council of Economic Advisors issued a report detailing the economic benefits that would be derived from telecommunications reform. The CEA predicts a boom in the telecommunications and information sector of the economy over the next ten years, doubling its share of the GDP, adding more than $100 billion to the economy, and employing another 1.4 million workers in that sector.

Fourth, innovation. Technological innovation is vital in the new knowledge-based global economy. Rapid and continuous improvements in products, and the techniques to manufacture and bring them to market more efficiently, give businesses—and nations—a competitive edge today and tomorrow.

In this environment, it is easy to see why the high-technology sector and firms that adopt advanced technologies are critical to economic prosperity. By some estimates, as much as forty percent of the nation's economic growth over the past fifty years is related to the development and use of technology. Average annual compensation in the high technology sector, moreover, exceeds by twenty percent the average for all manufacturing. High-technology products also account for a rapidly increasing share of the manufacturing output of industrial countries—35 percent in 1992, nearly double the 1980 figure.

The close connection between innovation and economic performance has been confirmed by new research from my own Department released only last month. Our report, entitled "Technology, Economic Growth and Employment," found that firms that use advanced technologies are more productive, pay higher wages, offer more secure jobs, and increase employment more rapidly than firms that do not.

The importance of this conclusion cannot be overstated. It is central to our economic fate. That is why my Department has focused its attention on this central question: How can we stimulate innovation in the U.S. economy?

Part of the answer comes from the connection between and among the four basic ingredients of growth that I have outlined. Each of the other three ingredients—investment, a skilled workforce and open markets—is integrally linked to the fourth, innovation. A sound macroeconomic environment, educated workers and markets in which innovation can produce competitive success are all necessary to the successful promotion of innovation.

Indeed, in each of the these areas, the Administration has taken action that is focused directly on the importance of innovation, including:

- winning Congressional approval for a three-year extension of the R&E tax credit and a targeted capital gains reduction for investments in small business;
- working with Congress to create the School-to-Work transition program for young people who choose not to go directly to college, and establishing Goals 2000 standards for K through 12 education;
- improving access to college loans so that our future scientists and engineers can get the education they need;
- freeing $32 billion in exports by reducing controls on U.S. computer and telecommunications products;
- stimulating major sales of technology-based products for U.S. companies through high-profile industry-government trade missions that helped close contracts worth more than $17 billion in U.S. exports, involving 275,000 American jobs—many of them technology related;
- developing a new Presidential policy on commercial remote sensing that allows private firms to build and operate high-resolution satellite imaging systems, which will create manufacturing and operation jobs;
- transferring 200 MHz of the radio frequency spectrum to the Federal Communications Commission for assignment to the private sector potentially through a competitive bidding process;

- negotiating commercial space launch trade agreements with the governments of Russia and China to create a level playing field on which U.S. providers can compete; and
- applying new technologies, from satellites to doppler radars, for better weather warnings and the protection of life and property.

And, the Administration also has provided adequate funding for basic science and applied research—even within the hard freeze on discretionary spending that the President has proposed continuing through Fiscal Year 2000.

We should recognize at the outset that the Contract with America would jeopardize that technology policy. Among the possible offsets proposed by the Contract are the elimination of our Advanced Technology Program and a freeze on funding for our National Oceanic and Atmospheric Administration, which conducts much of the Department's basic research. Moreover, generalized reductions in the President's investment spending, totalling more than $1 billion over five years, would further threaten our research and technology initiatives. For reasons that I will explain in detail, I hope that the Congress, after full consideration of our efforts, will continue the pro-science, pro-technology path that the President has forged and that is essential to our long-term economic prosperity.

Through all of these efforts, innovation can be spurred. But, for reasons that I will explain below, these measures alone are not sufficient.

The Need for Pro-Innovation Policies

The United States has been a leader in innovation. From the electric telegraph, to the telephone, television, personal computer and the manned mission to the moon, this nation has always looked to the future—and invented ways of getting there sooner.

The United States must remain the world's leader in innovation. To do that requires an understanding of the incentives that create—and the barriers that can stop—both the development and deployment of technology.

Technological innovation is a complex process. It is so complex that each industry—and even each firm within an industry—must grapple with a different set of concerns. For example, strengthening intellectual property protection is a key concern, particularly for the software industry. Cold war era export controls have hurt the U.S. computer and telecommunications industries. Regulation can be a major impediment by increasing the time and capital it takes to bring a new product to market—especially in biotechnology and pharmaceuticals. Both capital availability and access to technical expertise are continuing struggles, especially for our small- and medium-sized companies.

In short, there is no "one size fits all" formula for ensuring that our companies lead the world in innovation. Our national competitiveness strategy must address the broad range of factors that affect our companies' ability to develop technology, turn innovations into products and services and bring them to global markets at a rapid pace.

While innovation must continue to come from the private sector, government must work to maximize opportunities for private businesses to innovate—by reducing export controls, reforming regulations to give our companies and our workers elbow room to compete, by opening markets, by improving education, and by creating incentives for private industry to invest in long-range, high-risk research.

My department is pursuing a broad range of initiatives to improve the climate for private sector innovation. We are listening to industry as we establish departmental priorities, and serving as industry's advocate in shaping regulatory, export control and environmental policies. And we are partnering with industry to work on the nation's 21st century, technological infrastructure.

This partnership continues a long history of cooperation between the public and private sectors. For the greater part of two centuries, the government has worked as a junior partner with industry to build or encourage American infrastructure. That infrastructure has created a "playing field" upon which private enterprise built the most successful economy in the world. Government has built lighthouses and harbors for private sector shipping, offered federal rights-of-way for private sector railroads, built interstate highways, airports, advanced radar for aircraft, next generation doppler radar, and GOES satellites. By making investments that individual entrepreneurs, or even large companies, could not afford to make themselves, the government enabled everyone to become more efficient and productive.

And the government's investments in infrastructure have not been limited to our physical infrastructure. Since World War II, our national government has invested in science and technology as part of key national missions—defense of the nation, health, space, and the quest for new knowledge. And, for years, we have seen a steady flow of new commercial technologies emerge from these government investments as an extra benefit.

As a result of government's technology investments, the U.S. computer industry is the world's leader. We have seen a flow of blockbuster drugs and medical therapies, and the birth of the biotechnology industry—all of which can be traced to earlier government investments in defense technology or medical research. NASA's aeronautics research program has provided America's aircraft industry with the mid- and long-term technology development that a single company, no matter how large, could not afford to do on its own.

Times and technology have changed. We face stiff international competition in one field after another. Cycle times—the time from innovation to product—have shortened in most industries. We can no longer hope that a technological breakthrough spurred by a national security or mission need will be first to market.

Today, we seek—and need—a different model, one which focuses explicitly on civilian industrial technology and better connects the federal basic research mission to real-world private-sector commercialization—one in which private-public partnerships spur private sector investment in high-risk, long term innovations, with broad economic impact.

And development of technology is not enough. We must also consider the extent to which it actually reaches those who can employ it effectively. That is why, as a nation, we have supported the deployment of technology to people who might not have the resources to find it on their own. For example, beginning this January, the Department's National Meteorological Center will issue experimental seasonal climate forecasts for the contiguous United States and Alaska. These forecasts will lead to substantial immediate benefits to the U.S., including the agriculture and water resources management sectors, and other sectors dependent on seasonal variability.

The development and deployment of technology are both part of today's great national mission of providing all Americans with the tools of economic opportunity.

First, we must focus on the national interest. In the past, federal action was focused on specific missions: defense, aeronautics, energy or health. But today, our focus must be broader, because we do not have the luxury of three separate industrial bases for military, mission-oriented and commercial purposes.

Our mission oriented agencies—the Defense Department, the Department of Energy, and NASA—are no longer the dominant customer for most high technology. Nor are they in a position of technological leadership with respect to the commercial sector. In computers and semiconductors, for example, DOD consumes less than five percent of the U.S. market. In fact, the new technologies that are most critical to our military advantage—software, computers, semiconductors, telecommunications, advanced materials and manufacturing technologies—all are being driven by fast-growing commercial demand, not military, energy, or space demands.

Instead of looking for spin-offs down the road from some non-commercial purpose, we must examine the pursuit of civilian technology as a mission in and of itself, but we must do that only as a partner with industry.

Second, in examining that goal, we must recognize that all research and development and technology deployment is not the same. In this regard, we might usefully consider the nation's R&D expenditures as building a portfolio for the future.

As illustrated in chart 1 (attached), in 1993, industry funded nearly 55% of all U.S. R&D. More than 90% of that industrial research was concentrated on short-term commercial development and applied research. And properly so, for it is only the private sector that can connect today's market demands to immediate product development.

And as seen in chart 2 (attached), 59% of the Federal government's $69.7 billion R&D funding in 1993, and about one-quarter of all national R&D is related to the mission of defense. Health-related R&D accounted for about 15% of the Federal government's R&D spending, while about 10% went to the space mission.

Only about 4% of Federal R&D spending in 1993 went to civilian industrial technology and less than one percent went to the development of early-stage, pre-competitive civilian technologies. Science reports that less than one-twenty-fifth of industry R&D funds go to early stage, longer term, higher risk research. The Industrial Research Institute survey of industry R&D performance confirms press accounts that industry is reducing the level of investment in early stage research, with only 8% of firms expecting increases in this category of research in 1995.

The discovery of fundamental new knowledge, basic research, is a vital component of our innovation portfolio. But it is not enough. We have learned over the past twenty years that, all too often, U.S. discoveries of basic knowledge were better exploited by other countries that were better able to develop applicable technologies and transform them into competitive products and services. The marketplace alone will not invest sufficient resources into mid-and longer-term broad-based technology development needed by the private sector to fully exploit basic knowledge. Our industry-led technology development partnerships are an important link between basic science and private sector commercialization. We should continue to expand these efforts, not abandon them.

Although it is an oversimplification, we can think of basic research as providing the basis for commercial products a decade from now. Industry R&D focuses on short-term product delivery, often no more than 18 months hence. In between are needed efforts to move fundamental knowledge into technologies that industries can turn into new processes and products. In addition, a strong technology base often feeds back into scientific inquiry in a way that leads to fundamental advances in our understanding. Science and technology support one another. The importance of the technology development activities has not been lost on our international competitors.

Consider the R&D expenditures of our major trading partners, which are illustrated in chart 3 (attached). As a percentage of GDP, we lag behind Japan and Germany, and are roughly on par with France and the United Kingdom. And, over the past decade, average annual growth of R&D investment has been increasing by more than 7.5 percent per year in Japan, while our growth rate has been flat. Our trade balance for high-tech manufactured goods—so important to our long-term economic stability—has steadily eroded over the past 15 years and been negative for nearly a decade.

As I have said before, today we are clearly doing better as a nation. But we must not let America's recent strong economic performance mask long-term structural problems. It has been cost-cutting reductions in waste and inefficiency—not long-term investments—that have sustained our current economic revitalization. We have cut the fat. Now we have to build the muscle.

Today, we are moving down the long-term path to meet the competition. And, as explained below, we are doing it through our own industry-led partnerships. We should not abandon them.

Like any portfolio, the mix of R&D activities must reflect a balance between long-term and short-term goals. Good research and development is like a fruit tree; it must be planted years before it can be harvested. Thus, although the private sector does a good job of planting short-term crops, there is insufficient incentive in the marketplace to engage in the development of long-term, higher risk enabling technologies.

The majority of the R&D in which American businesses invest offers strong promises of quick return—in other words, less risky, product-oriented and bottom-line effective projects applauded by the Chief Operating Officer. Good for business in the short term, but lacking the long-range scope of high-risk but high-payoff technologies that American business must develop to be competitive in the future.

Third, we must examine the extent to which technology, once developed, is actually available to those who can build our nation's economic strength. This goal, of bringing technology to users who can make it work for our country, is as American as the agricultural extension service, perhaps the most successful governmental technology program in our history. Today, that goal is being served through our Manufacturing Extension Partnership, which brings to our nation's small- and medium-sized manufacturers access to information resources, and expertise on modern manufacturing technologies and production processes which they need to remain competitive.

Some have argued that more generalized incentives for research and development—such as R&E tax credits—are more effective than the Advanced Technology Program (ATP) at encouraging private sector research. I want to emphasize once again that there is no one policy or program that ensures competitive success. The R&E tax credit is an important tool for encouraging greater private sector investment in research and development. That is why the Clinton Administration supports extension of the R&E tax credit. However, the R&E tax credit does not differentiate between, investments directed toward short-term product delivery and longer term, higher risk investments that will yield products fifteen or twenty years into the future.

Clearly, we need both of these tools as part of our pro-innovation strategy.

Our national capability to engage successfully in international competition is dependent upon our national technological prowess. Where government should get out of the way, we will. Where government should work in partnership with the private sector, we must do so. Any other course would forego a critical element of national competitiveness.

III. Partnering the Growth of Civilian Technology

To meet the challenges that I have outlined, this Administration is committed to providing Americans with the tools they need to meet both the challenges of global competition and the need for constant innovation. Our roles is to provide an environment which empowers our workers and businesses and communities to embrace change—with a government that works with them. Just as we provided the traditional tools for success in agrarian and industrial times—including public education and the basic infrastructure of commerce from the Erie Canal to the national highways systems of this century—now we must empower Americans with the tools to succeed in a global, high-technology, information-dominated society.

The Department of Commerce's focus on civilian technology has three basic components, each designed to enhance the technological capabilities of American industry. We emphasize:

—Supporting industry-led technology partnerships,

—Facilitating the rapid deployment and commercialization of civilian technologies, and

—Facilitating a technology infrastructure for the 21st Century.

Mr. Chairman, appended to my testimony is a short description of each of our Department's science and technology activities. For purposes of this testimony, however, I would like simply to describe each of the basic components of our policy.

A. Supporting Industry-led Technology Partnerships

Mr. Chairman, I have already described the basic rationale of our Advanced Technology Program—to address the market gap in our mid- and long-term R&D portfolio which threatens to make us less competitive as we approach the 21st century. and beyond.

Governmental action to redress market defects that threaten national prosperity is scarcely novel. For example, the laws establishing intellectual property rights are designed, in a similar manner, to correct market imperfections by establishing rules of conduct that must be obeyed. In the international context, we are working hard to have rules of conduct uniformly adopted.

The ATP program is a carefully-targeted remedy for the problem our nation faces. By sharing the costs of research, it reduces the risk for private businesses, thus allowing them to conduct research and development that might otherwise not be conducted at all—a wise investment for our nation as a whole. Through a rigorous, merit-based review, the ATP program ensures that funded research has both technological and commercial potential. And, with a bottom-up, private sector approach, the ATP program maintains private-sector priorities, not government fiat, as the driving force for technological achievement and focus.

Because of the risk involved, some projects will fail. Others may proceed faster than anticipated. But let me make this clear: it is the company that picks up the cost of product development, not the ATP.

The strength of the ATP—and the-reason that it is a solid and successful part of the nation's technology portfolio—is that the program is a true partnership with industry. While government provides the catalyst—and in many, cases, critical technical support—industry conceives, cost-shares, manages and executes ATP projects. Management of projects is geared to ensure that the work performed is what industry believes should be done and is what it can do best.

The ATP relies on the substantial involvement of industry to define and implement its R&D programs. ATP research directions are selected based on direct input from industry and developed in consultation with industry. Specific R&D projects are selected from proposals developed and submitted by industry in response to announced competitions.

The ATP emphasizes cost sharing—ATP recipients on average pay more than half the total costs of the R&D. This ensures that companies have a vested interest in the success of projects and in timely commercialization, and that they will engage in the R&D only because it makes sense as a matter of commercial policy. At the same time, participation by small companies and start-ups is made easier by allowing the single applicant's cost share to be its indirect costs, which are usually low. The first four years of the ATP have shown small businesses to be eager participants. As chart 4 (attached) shows, of the awards made since 1990, roughly half have been to individual small businesses or joint ventures led by small businesses.

Thanks to strong support from its industrial partners, the ATP already has documented a number of success stories in its short lifetime.

Let me illustrate a couple of key features of the Advanced Technology Program with an actual project. In 1992 we announced an award of just under $2 million to a small, California company called Accuwave. The company was formed to exploit an intriguing new technology; they use laser holography to "write" very high-resolution optical elements such as filters in the interior of special crystals. They proposed to try to use this technology to build special optical elements for mixing and separating individual beams of light such as those carried on long-distance fiber-optic cables. If it works, the Accuwave technology will allow existing fiber-optic cables to carry as many as ten times the current number of channels. The impact on the telecommunications industry could be enormous.

So let's consider this project. Can a small entrepreneurial company benefit from the ATP? Mr. Chairman, when Accuwave submitted its proposal, the company was only two years old. It succeeded in a rigorous competition that funded only about 15 percent of applicants that year, and it succeeded on the strengths of its technology and its plan for eventually commercializing the work.

Are we spending tax dollars on product development? Mr. Chairman, I can't say this too many times: The ATP does not pay for product development. We work in areas where there are important, chancy technical issues that must be resolved before a company can even think about product development. Accuwave, for example, did its early work in developing special filters for solar astronomy. Applying its technology to optical communications requires, for one thing, that Accuwave work in a whole new part of the spectrum, and meet a number of system integration challenges new to it. That's the ATP project.

Are we substituting tax dollars for private capital? Mr. Chairman, there was no private capital for this. Accuwave was a small, new firm with ten people and no track record in the huge, highly competitive telecommunications industry. It didn't have the in-house resources to do the project, and without the ATP it wouldn't have had external finding either—the risks were just too high.

On the other hand, with the ATP, Accuwave has already made important progress. I hold in my hand a device called a "wavelength locker". Its purpose is to stabilize and control the wavelength of a communications laser and improve network performance. This little module, designed for easy use on a circuit board, replaces a tabletop full of optical equipment. It's based on ATP-sponsored research.

It's unique in the field. It could be the forerunner of a whole family of new, world-class products in a field with huge commercial potential. It is a technology that would not be entering the market now without the assistance of the ATP to overcome the early technical hurdles.

That is what the Advanced Technology Program is about

From its start, the ATP has emphasized detailed program evaluation as critical to an effective, results-oriented program. The evaluation plan for the ATP calls for metrics for process efficiency, short-to-medium term results, and long-run economic impact, and the ATP is actively pursuing each. Recognizing that a major obstacle to comprehensive, accurate measurement metrics typically is the lack of good data, the ATP has put in place an extensive data collection system. Because assessing the long-run national benefits of technological change is challenging, the ATP has engaged the advice and services of some of the nation's leading experts in the economics of innovation. It has completed several studies of short-to-medium term results and has several experimental studies underway to project longer-term impacts. It is putting in place the data and evaluation tools that it will need to measure real long-run program payoffs in U.S. economic growth and jobs as soon as sufficient time has passed to make this possible.

And, early results indicate that the ATP is successfully improving the capability of the nation's businesses to capture economic returns from scientific and technological innovations. Two independent studies of projects funded in FY 1991 revealed substantial, early beneficial impacts on participating companies, including expanded R&D activity, particularly the ability to engage in high-risk, long-term research with high-payoff potential; cost and time savings, improved productivity, and other benefits from industry-industry, industry-government, and industry-university collaborations; improved competitive standing; formation of valuable strategic business alliances; improved ability to attract investors; assistance in converting from defense to commercial applications; and acceleration of technology development, leading to improved market share.

This is how the ATP fulfills an industry need that no other government or private-sector program can fill. By funding enabling technologies that most investors consider too risky, the ATP provides U.S. businesses with a bridge from today's innovative promises to tomorrow's breakthrough products and processes.

When I came into office, I said that if John Major or Francois Mitterand could travel around the world advocating on behalf of their nation's products, we could as well. And we have done just that. Here, too, why should we stand by and watch other nations prepare themselves for the future—making their nations more attractive to the pursuit of long-term technologies, with the attendant economic benefits that brings, while we stand by inactively? We should not. Scaling back Federal investment in long-term, high-risk technology R&D is tantamount to unilateral disarmament in a fiercely competitive world marketplace.

B. Facilitating the Rapid Deployment of Civilian Technologies

Stimulating the development of innovative technologies is one-half of the equation. The other half—getting new and existing products to market in a timely, cost-effective competitive basis is also critical if U.S. firms are to succeed in the global marketplace.

As part of those efforts, the Administration fully recognizes the fundamental role that our 370,000 small- and medium-sized manufacturers play. These firms are the source of two-thirds of our manufacturing jobs, account for 75 percent of new manufacturing jobs, and contribute more than half the value-added in manufacturing in the United States.

These facts advocate for expansion of the Manufacturing Extension Partnership (MEP)—and for the potential that this program has to make a difference. The success of the agricultural extension service over the last 100 years in building an agricultural industry that is the envy of the world—is a strong precedent for the MEP.

Today, as illustrated in chart 5 (attached), there are 44 extensions centers already operating or soon to be operating in 32 states. By achieving the President's goal—to establish a nationwide network—the nation's 370,000 small- and medium-sized manufacturers will have easy access to modern manufacturing technologies, production techniques and best practices through the MEP national system.

The network of manufacturing extension centers is growing because the centers are industry-driven, responsive, and focused on positive bottom-line impacts. Each center tailors its services to meet the needs of manufacturers in its region. And it is the centers' customers who indicate the impact those services have on their firms' performance—in terms of sales, capital spending, inventory costs, productivity, and other bottom-line factors. The results are staggering. A recent analysis found that the economic benefits to client firms—in terms of enhanced responsiveness to customer demands, reduced-waste and inventory, and increased sales—resulting from assistance from a center exceed the Government's cost at a rate of seven to one.

Manufacturing extension services are supported by governors, mayors, and CEOs because they understand the unique barriers facing small- and medium-sized manufacturers and the need for making appropriate technology, information and resources more accessible to them. Historical experience indicates that smaller manufacturers cannot easily overcome these barriers without external assistance. Furthermore, the extension services provide essential customization of new technologies and process applications adapted to firm-specific operating environments. They also understand the prospective payoff of such services—and the prospective losses, if these companies do not make the changes needed to remain competitive.

C. Facilitating a Technological Infrastructure for the 21st Century

For nearly a century, the primary responsibility for the constitutional mandates to "fix weights and measures" has fallen on the research laboratories of the National Institute of Standards and Technology, the only federal laboratory specifically commissioned to work with U.S. industry toward improving U.S. competitiveness. The laboratory research program at NIST is a crucial component in this Administration's strategy for competing successfully in the critical industries of the 21st century. Infrastructural technologies such as measurement methods, fundamental standards, materials property data, testing techniques, and advanced instrumentation provide manufacturers with the essential tools to continuously improve both their products and processes. NIST infrastructural technologies also speed market acceptance of advanced technologies by providing buyers and sellers with objective and technically sound methods with which to agree upon and assure product characteristics and performance. In order for U.S. industry to be able to implement changes necessary to remain competitive in the global marketplace, theses basic tools require constant improvement. Without this continued development, U.S. firms in many emerging high-technology fields—such as biotechnology, optical electronics, advanced manufacturing and materials, and high-performance computing and communications—will lack the underlying measurement technologies and standards necessary to make quality products for future global competition.

NOAA is an integral part of the Department's technology R&D portfolio. NOAA's science has played an important role in U.S. strides in achieving improvements in environmental quality, managing natural resources more wisely, and understanding and predicting the behavior of earth systems so as to ensure sustainable economic opportunities. NOAA's scientific research supports its two missions—environmental assessment and prediction, and environmental stewardship.

NOAA assesses and predicts environmental changes on different time scales. NOAA improves its short term weather forecasts through research into basic hydrometeorological processes and through the development of new observational technologies, such as doppler radar. Future improvements in forecasts and warning services will continue to enhance U.S. capabilities to mitigate adverse environmental conditions impacting safety and productivity, from managing evacuations during hurricanes to routing airplanes efficiently.

NOAA's research into the El Niño-Southern Oscillation phenomenon has led to the development of experimental seasonal climate forecasts. By the year 2015, NOAA should have the capability to produce multiseason forecasts of precipitation with accuracies approaching those of current short-term forecasts.

Long-term changes in the global environment may alter the capacity of the Earth to sustain life. NOAA's research involves documenting and understanding these changes, leading to the development of models for their prediction. NOAA's basic research into atmospheric chemistry has led to immediate solutions for mitigating ozone depletion in the Earth's atmosphere. NOAA research on climate change will provide the basis for forecasts of decadal and longer changes with predictions of sufficient scientific credibility to support decisions.

NOAA's second major mission is stewardship of the coastal environment. NOAA's stewardship responsibilities include building sustainable fisheries, recovering protected marine species, maintaining healthy coastal ecosystems, and providing navigation and positioning services. NOAA is conducting and integrating the results of research efforts in multiple fields to better manage its responsibilities in these areas.

These efforts include improving fishery stock assessments using new technologies, such as hydroacoustics; and conducting habitat and marine biodiversity studies which will aid in recovering a number of protected marine species, such as the salmon in the Pacific Northwest. As coastal populations grow rapidly, NOAA is providing information for management decisions designed to promote sustainable economic growth in coastal regions, and to restore and conserve coastal ecosystems.

NOAA will meet national needs for improving navigation and positioning services. By exploiting emerging technologies, such as the Global Positioning System, NOAA will produce and integrate data, based on satellite geodetic positioning, and will improve a number of data products for clients who can utilize this real-time environmental information.

In addition to NIST's and NOAA's infrastructure work, the development of the National Information Infrastructure (NII) and its counterpart, the Global Information Infrastructure (GII), is a top priority. These initiatives will promote a stronger economy, more competitive businesses, more effective government, and better educational and technological leadership. The private sector is constructing the NII and GII. The Federal government is acting as a catalyst to promote its development and to ensure that the initiatives are accessible and affordable to all Americans. The Administration's NII and GII initiatives seek to ensure that all Americans can take advantage of the opportunities brought by the advanced information technologies and services—a market that approaches 10 percent of our domestic economy.

The Commerce Department is focusing on a number of goals, chief among them are privatization and liberalization of markets, open standards, protection of intellectual property rights, regulatory flexibility, technology policy analysis and advocacy, and stimulating innovative applications. As a means of facilitating the private sector's development and use of NII applications to advance the public good, the Administration is funding NII demonstration projects such as telemedicine and distance learning. Last year the Commerce Department made its first competitive awards under the Telecommunications Information Infrastructure Assistance Program (TIIAP). The program is providing matching funds to state and local governments, nonprofit health care providers, school districts, libraries, universities, public safety services, and other non-profit entities in 44 states, the District of Columbia and the Virgin Islands. The TIIAP will help demonstrate to Americans at the local level the advantages of having access to modern, interactive information infrastructure.

I firmly believe that if you look:

- at what our policies and programs are striving to accomplish,
- at how they are being driven by private sector needs and by their contribution to reaching our society's goals, and
- at the results that we are beginning to deliver,

you will come to the conclusion—and agree—that these efforts are making a real contribution.

IV. Conclusion—The Role of the Department of Commerce

I would be remiss, Mr. Chairman, if I concluded without discussing another implication of the new economic challenges our nation faces.

In an era of re-inventing government, some have questioned the nature of the activities housed in, or even the existence itself, of the Department of Commerce. Such criticism usually focuses on the differences between the activities that I oversee: fisheries management and manufacturing centers; export promotion and control, and domestic economic development; the Census Bureau and minority business enterprise; and weather forecasting and economic statistics.

To emphasize the differences is, however, to miss the point. If my testimony today has emphasized anything it is this: We live in an increasingly competitive global economy in which all aspects of economic competitiveness are integrally connected. Trade policy opens opportunities for high-technology companies. Technological proficiency is a key ingredient to economic development in the United States. Economic development will often turn on our ability to sustain environmental resources and provide a predictive capability for environmental change. Measuring and monitoring resources is an important part of the economic information that we collect and the economic analyses that we perform.

The Department of Commerce is where these connections are made. We focus on economic growth and competitiveness and, within our ten bureaus, we work, in a myriad of ways, toward the complementary goals of economic growth, job creation, an increasing standard of living, and environmental protection. And we work better, in every respect, because we are, every day, confronted with the intersection of trade promotion, civilian technology, economic development, sustainable development and economic analysis.

That intersection is where the future of the United States economy is being fashioned, every day, by entrepreneurs who forge our future one deal, one contract and one transaction at a time. My Department works with them everyday, to our mutual—and our future—benefit.

Thank you.

CHART 1

Enabling the Nation's Capacity to Perform in a Global Community

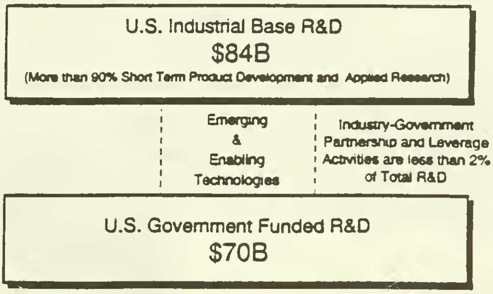

U.S. Industrial Base R&D
$84B
(More than 90% Short Term Product Development and Applied Research)
Emerging & Enabling Technologies
Industry-Government Partnership and Leverage Activities are less than 2% of Total R&D
U.S. Government Funded R&D
$70B

CHART 2

Federal R&D Funding for Defense & Civilian Functions, 1993

Source: NSF "Federal R&D Funding by Budget Function: FY 1991-93" and unpublished NSF data.

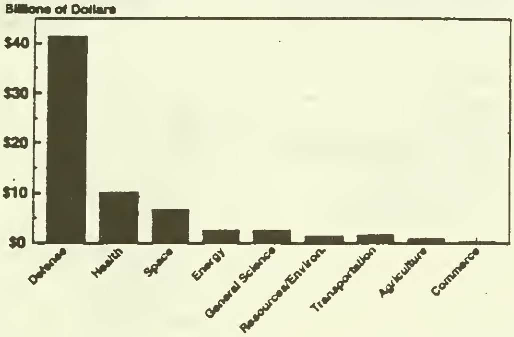


CHART 3

National Nondefense R&D as a Percentage of GDP, by Country, 1981, 1986, 1991

Source: NSF S&E Indicators-1993

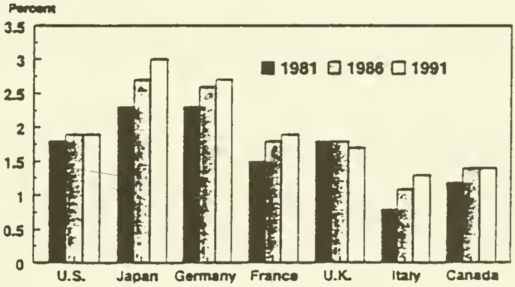
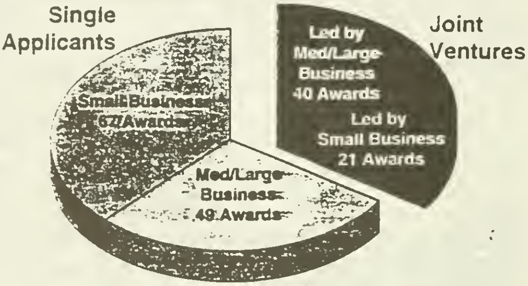


CHART 4

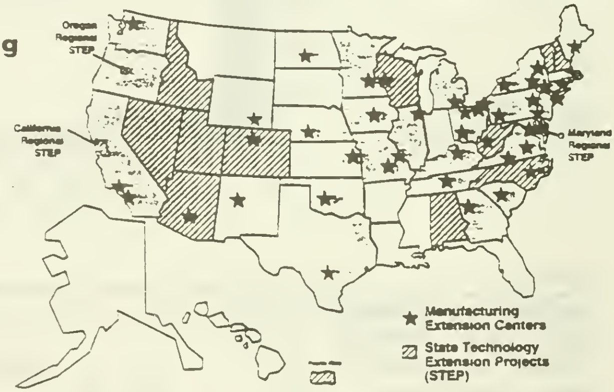
ATP Awards 1990-1994
By Type of Organization



Awardees include 158 small businesses, 221 med/large businesses, and 32 universities. 100 subcontracts have also gone to universities.

CHART 5

NIST Manufacturing Extension Partnership


Oregon Regional STEP
California Regional STEP
Maryland Regional STEP
★ Manufacturing Extension Centers
▨ State Technology Extension Projects (STEP)

APPENDIX—THE DEPARTMENT OF COMMERCE SCIENCE AND TECHNOLOGY ACTIVITIES

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Introduction

The National Oceanic and Atmospheric Administration (NOAA) has set forth a vision for the year 2005 of a world in which societal and economic decisions are coupled strongly with a comprehensive understanding of the environment. NOAA's mission is to describe and predict changes in the Earth's environment, and conserve and manage wisely the Nation's coastal and marine resources to ensure sustainable economic opportunities.

Over the past 25 years, the U.S. has made important strides in improving environmental quality, managing natural resources more wisely, and understanding and predicting the behavior of Earth systems. NOAA sciences and services have played an important role in this evolution. As we approach the 21st century, we face continuing and complex environmental challenges. In the next twenty years, investments in science and technology will revolutionize these national services, with returns on investment through economic growth and improvements in the quality of life.

NOAA's Strategic Plan.

NOAA's Strategic Plan for 1995–2005 defines the goals necessary to fulfill our vision. The plan transcends internal organizations, and promotes synergy, innovation, cooperation and efficiency. The program strategy consists of seven inter-related goals. The seven goals are grouped under our two primary missions of Environmental Assessment and Prediction and Environmental Stewardship. Achievement of our goals depends strongly on NOAA's capabilities as a national resource for environmental research, observational systems, and data and information systems.

Environmental Assessment and Prediction

Advance Short-Term Warning and Forecast Services. Our dynamic environment presents extraordinary challenges for protecting life and property. NOAA is improving its short-term forecast and warning products by enhancing abilities to observe, understand, and model the environment, and by effectively disseminating products to users. NOAA research contributes to this goal through advancing basic hydrometerological understanding and the development of new observational technologies. Significantly improved short-term forecast and warning services will be implemented for the global environment that will enhance capabilities to mitigate adverse environmental conditions impacting safety and productivity.

Implement Seasonal to Interannual Forecasts. This month, the National Meteorological Center will begin issuing experimental seasonal climate forecasts for the contiguous U.S. and Alaska. This capacity is the direct result of research performed over the last decade on the El Niño-Southern Oscillation, or ENSO, phenomenon, and of key new observing capabilities. Seasonal forecasts will lead to immediate benefits, especially in, the agriculture and water resource management sectors. The terrible flood of 1993, and the loss of returning salmon in the Northwest, have been connected to El Niño events. By the year 2015, we should have the capability to produce multiseason forecasts of precipitation with accuracies approaching those of current short-term forecasts.

Predict and Assess Decadal to Centennial Change. Long-term changes in the global environment may alter the capacity of the Earth to sustain life. Prediction and assessment on decadal-to-centennial time scales will require: improved process understanding; operational observations of global changes; and improved global models providing predictions. NOAA research on ozone chemistry is having immediate payoffs for industry and is providing input to international assessments. NOAA research on climate change will provide the basis for forecasts of decadal and longer changes with predictions of sufficient scientific credibility to support action.

Environmental Stewardship

Build Sustainable Fisheries. NOAA his implementing programs to restore the wealth of U.S. fisheries. Current investments in biotechnology, sampling technology, and ecosystem dynamics research will make a significant difference in how NOAA addresses this rebuilding. Better understanding and knowledge leads to sustainable fisheries and enhanced economic opportunity for the country.

Recover Protected Species. NOAA must protect and plan for the restoration of marine species threatened with extinction. Principal research paths include improving stock assessment methodologies and genetic approaches to stock identification. The goal is to recover protected species in danger of extinction in a manner compatible with sustainable use of marine resources.

Coastal Ecosystems Health. As coastal populations grow rapidly, NOAA is providing the research, monitoring, assessments, predictions and guidance for management decisions designed to promote sustainable economic growth in coastal regions, and to restore and conserve coastal ecosystems. NOAA's coastal research efforts build on existing strengths in coastal water quality, habitat and marine biodiversity. Improved environmental indicators and integrated coastal management will, for the year 2015, support an ecosystem-wide approach toward coastal ecosystem health and prosperity.

Modernize Navigation and Positioning Services. NOAA is exploiting, emerging technologies and redefining its products and services to meet the Nation's need to produce and integrate chart data, satellite-based geodetic positioning, and real-time environmental information. NOAA will supply, in the 21st century, improved positioning services to ensure the safety of life, property and the environment, while supporting economic growth.

National Capabilities

Along with research, NOAA must continue to invest in its capabilities as a national resource for observational systems and environmental data and information services. We must seek to implement an integrated global observing capability, while ensuring that data are processed, analyzed, and distributed in a timely fashion.

THE TECHNOLOGY ADMINISTRATION (INCLUDING NIST)

The Office of Technology Policy

The purpose of the Office of Technology Policy is to improve U.S. industry competitiveness. It fulfills its mission by advocating policies which empower; the private sector to compete, and implementing and managing Congressionally mandated programs that increase U.S. companies access to the best foreign science and technology. OTP also serves as a technology policy think tank.

Through extensive interaction with the private sector, and an "industry as customer" focus, OTP has determined that a comprehensive policy approach to U.S. competitiveness is essential. Such an approach must address the broad range of factors that impact the ability of companies to develop technology, turn it into products and services, and bring them to the global marketplace.

OTP, in partnership with private-sector leadership, is evaluating and promoting policies that promote competitiveness and economic growth. This includes efforts to:

I. Improve the business climate for private-sector innovation and investment.

II. Improve the efficiency and effectiveness of Federal civilian technology efforts to maximize their impact on competitiveness, economic growth, and job creation. The focus is "industry as customer."

OTP is striving to become a "first stop" for the private sector in its efforts to work with the federal government on issues affecting industrial competitiveness. Its attention has been focused on orchestrating efforts across the federal government or acting as a catalyst and facilitator for industry action.

Business Climate Initiative

The Business Climate Initiative seeks to promote the enhancement of the overall climate for technological innovation by identifying, exploring, and advocating policy reforms. Starting by listening to the concerns and recommendations of private industry, this initiative provides a forum and a vehicle for constructive consensus-building around a variety of changes—regulatory, capital formation, and other policy areas—in order to improve U.S. industrial competitiveness. Whether through immediate administrative modifications or more structural statutory and regulatory reforms, the Business Climate Initiative will give credibility and coherence to the federal government's efforts to improve the U.S. business environment on the basis of industry's priorities.

International Policy Projects

OTP is working to ensure that U.S. firms have access to the foreign science and technology programs that will strengthen their ability to compete in today's global markets. It does this through the identification, gathering, and dissemination of valuable but not easily available science and technology information—such as that on developments in Japan—and by helping place U.S. engineers in Japanese manufacturing companies for extended periods of time under the Manufacturing Technology Program. OTP is also responsible for the development of new forms of international collaborative scientific and technological activities that will enable U.S. firms to benefit from the expertise available in other countries. Collaborative agreements include the Intelligent Manufacturing Systems Program and the U.S.-Israel Science and Technology Commission, as well as programs that support foreign policy initiatives such as those with Northern Ireland and Egypt.

Manufacturing Assessment Study

OTP is assessing the health of the nation's manufacturing base. This assessment is intended to provide insight on the make up and geographic distribution of manufacturing firms in the U.S. This work is being conducted with the Center of Economic Studies within the Census Bureau to compile statistics derived from the Census of Manufacturers. Input from individual industry trade associations and state and regional manufacturing assistance organizations also has been collected. The report will be released in the first quarter of 1995.

Benchmarking Industrial Competitiveness

At the firm level, the practice of "benchmarking" one's operations against those of competitors is a well-established means of assessing and improving competitiveness. At the industry level, a number of industry associations and university research centers around the country have undertaken the task of benchmarking "competitiveness" that is, an industry's ability to sell at a profit its goods, and services under free and fair market conditions, worldwide.

One objective of this OTP initiative is to expose a broader cross section of industry to the potential benefits of conducting benchmarking exercises. Another is to identify potential government information sources for such exercises and where appropriate, improve the types of information provided by government to the private sector for this purpose. Finally, our staff is examining on an industry-by-industry basis, the relationship between regulatory, tax, trade, and technology policies, as a direct response to concerns voiced by industry over the seemingly ad hoc and sometimes contradictory nature of government policies.

Efforts are currently underway in twelve sectors to prepare initial competitiveness benchmarking reports. These efforts are all characterized by cooperation between government, industry and academia, and involve more than 100 of the country's leading experts in matters of industrial competitiveness. The draft reports will be reviewed by panels of industry and academic experts, beginning in the spring of 1995, and will be issued in final form by the end of the year.

Federal Partnerships Project

It has been almost fifteen years since the Federal government first began addressing issues of competitiveness through public private partnerships. OTP is evaluating the effectiveness of these various partnership models and developing metrics of success for these programs. Once again, the report will be founded on the experiences of the private sector in working with the various programs, drawn from roundtables with the private sector companies and industry associations. The report will present profiles of the programs, their funding, constituencies, key features, and key issues.

The National Institute of Standards and Technology

NIST's primary mission is to promote U.S. economic growth by working with industry to develop and apply technology, measurements, and standards—providing the basic technical infrastructure needed by U.S. industry. Both small and large companies are assisted by NIST. NIST's priorities are set and results are measured on the basis of benefits realized by the U.S. economy.

NIST's appropriation of $855M in FY95—the only portion of the federal budget explicitly devoted to enhancing industry's critical technology infrastructure needs—is just over one percent of federal R&D and less than one-half of one percent of the nation's total R&D expenditures.

NIST carries out its mission through a portfolio of four major programs which are described below.

NIST Laboratory Programs

For nearly a century, researchers at NIST laboratories have supported the growth and competitiveness of U.S. industry by providing high-quality, science based measurement and standards research and services. The NIST laboratories serve the needs of large and small companies and individuals from virtually all sectors of the economy. Laboratory efforts are planned and conducted in cooperation with industry and focus one infrastructural technologies such as measurements, standards, evaluated data, and test methods which provide a common basis for science, technology, and commerce.

NIST provides vital elements of the measurement and technical infrastructure which makes possible much of the development, production, distribution, and sales of manufactured products. NIST laboratories support the U.S. economy in three critical ways:

I. By providing measurement technologies, evaluated data, materials characterizations, and test methods, NIST furnishes industry with an organized, verified technical infrastructure which firms depend upon to predict, perform, measure, and analyze ever more complex and technical activities in a rigorous, effective, and timely manner.

II. NIST labs work with industry to develop and maintain technologies and services—from advanced process and quality control measurements, to improved test and measurement methods, to national reference standards and calibration services—that enhance U.S. industry's ability to provide high quality, competitive products and services.

III. By working with industry as a non-regulatory, unbiased third-party to develop technical underpinnings for standards, establish conformance tests, and facilitate the private-sector voluntary standards process, NIST accelerates market development and increases the efficiency of market transactions by promoting improved communication, consistency, and trust among technology buyers and sellers.

The benefits from this work are spread across many companies and industries. Industry traditionally under-invests in development of these infrastructural technologies because they are used simultaneously by many firms and typically are not embodied in products, making it difficult or impossible for individual firms/industries to recover the R&D investments.

The NIST research programs are carried out in eight major Laboratories, with specialized products and services offered through a Technology Services unit.

The *Electronics and Electrical Engineering Laboratory* (EEEL) provides the fundamental basis for all electrical measurements in the U.S. In consultation with industry, researchers tailor programs to meet the most critical measurement needs in the manufacture of semiconductor, magnetic, RF, microwave, optical, optoelectronic, and superconducting products, as well as electrical power systems. These researchers develop improvements in quality control and cost effectiveness for both current and next-generation semiconductors; produce methods that help increase the efficiency of optical fiber networks; and operate specialized computer facilities to develop new standards and performance measures for flat-panel displays and high-definition televisions systems.

The *Manufacturing Engineering Laboratory* (MEL) has primary responsibility for maintaining the national standards for dimensional metrology. Researchers in MEL are helping to develop many of the tools for automated intelligent-processing systems that will soon be the core of all world-class manufacturing operations. These components include intelligent machines; advanced sensors for real-time in-process measurements; software for precision control of machine tools; and information technology for integrating all elements of a product's life cycle, from planning and design through marketing and customer support. MEL also provides technical support for industry groups that develop standards for measurements, measurement techniques, hardware, software, and data interfaces.

The *Chemical Science and Technology Laboratory* (CSTL) maintains the national system of chemical measurement and coordinates the system with those of other nations. CSTL also develops the calibration and measurement standards for a wide range of instruments and processes important to the chemical-manufacturing, energy, health-care, biotechnology, foodprocessing, and materials-processing industries.

The *Physics Laboratory* (PL) attends to the long-term needs of many U.S. high-technology industries. PL conducts basic research in the areas of quantum, electron, optical, atomic, molecular, and radiation physics. This research includes, for example, efforts to improve the accuracy and precision of time and frequency standards. Much of the laboratory's research is devoted to overcoming the measurement barriers to the next technological revolution, in which individual atoms and molecules will serve as the fundamental building blocks of electronic and optical devices.

Programs in the *Materials Science and Engineering Laboratory* (MSEL) cover the full range of materials issues, from design, to processing, to performance. The unifying aim is to acquire the knowledge and tools needed for intelligent manufacturing methods with real-time, automated process controls. Special research initiatives address ceramics, metals, polymers, composites, and superconductors. This research supports efforts by U.S. industry to develop reliable, low-cost manufacturing methods for producing tailor-made materials and products with superior properties.

The major goals of the *Building and Fire Research Laboratory* (BFRL) are to improve the productivity of the U.S. construction industry. Through performance prediction and measurement technologies, as well as technical advances, the laboratory works to improve the life-cycle quality of constructed facilities. The laboratory studies building materials; computer-integrated construction practices; structural, mechanical, and environmental engineering; and fire science and fire safety engineering. Products of the laboratory's research include measurements and test methods, performance criteria, and technical data that are incorporated into building and fire standards and codes.

The *Computer Systems Laboratory* (CSL) benefits both users and manufacturers of computer and telecommunications technology. Its research and testing programs foster the orderly development of an "open systems" environment intended to make all forms of information technology compatible and interoperable. For manufacturers of hardware and software, industry-wide adoption of standards expands marketing opportunities, and users are freed of the constraints and frustrations of incompatible proprietary systems. Much of CSL's work consists of advising and assisting industry in developing standards that satisfy user needs and yet accommodate innovations that differentiate the products of competing vendors.

The *Computing and Applied Mathematics Laboratory* (CAML) develops mathematical, statistical, and state-of-the-art scientific computing tools that help NIST researchers and their collaborators in U.S. industry accomplish their research and measurement objectives. NIST mathematicians and statisticians also support U.S. industry through computer-aided modeling of complex manufacturing processes and statistical methods for improving the quality of products and processes. Other research programs focus on advanced computer graphics programs that produce two- and three-dimensional visualizations of complex problems; new methods for displaying, manipulating, analyzing, and transmitting large volumes of data; and software applications for harnessing the problem-solving power of parallel processors.

Through *Technology Services* (TS), NIST provides a conduit to a wide variety of services and programs to help U.S. industry improve its international competitiveness, commercialize new technologies, and achieve total quality in all facets of business operations. Companies spanning all industrial sectors depend on the precision and reliability of NIST measurement services and products to keep their production processing smoothly, efficiently, and safely. NIST reference materials, data, and calibrations help industry maintain quality control in the production of everything from aerospace alloys, to voltmeters, to breakfast cereals. Responding to increased emphasis on quality standards in international markets, NIST provides information and assistance to about 20,000 organizations and individuals every year concerning national and international voluntary and regulatory product standards and certification systems.

Setting Priorities. NIST programs are guided by measurement and evaluation systems which are used to set priorities, evaluate operational performance, and assess near- and long-term returns on investments and activities. Priorities are set, and results measured, on the basis of benefits realized by U.S. industry. Priorities in NIST's laboratory are set in consultation with industry and in accordance with several guiding criteria including the magnitude and immediacy of industrial need; the degree of correspondence between particular industrial need and NIST's mission to develop and support infrastructural technologies; opportunity for NIST participation to make a major difference; nature and size of the anticipated impact; NIST's capability to respond in a timely fashion and with a high-quality solution; and the nature of opportunities afforded by recent advances in science and technology.

Measuring Results. NIST laboratories use a variety of measures to track and evaluate performance, including the value and utility of research deliverables and services. Customer feedback, gathered through many mechanisms, is the principal source of evaluative information. NIST's primary "deliverables"—measurements, standards, evaluated data, process models, etc.—are made widely available to U.S. industry, usually in the form of technical information or publications. Measures of the relevance and value of this information include industry attendance and level of participation at NIST's technical workshops; commercialization of products incorporating results of NIST R&D; application of NIST R&D results to industrial processes; level of industry commitment to NIST projects and consortia; number of guest researchers from industry; and repeat customers.

Developing methods for measuring and quantifying the impact of tax payers' investment of resources in NIST's laboratories has very high priority. NIST has been at the forefront of efforts to develop methodologies for assessing the economic impact of laboratory research and has undertaken a series of assessments to determine the economic impact of selected laboratory programs and services. Using a method based on internal rate of return calculations used in industry, these impact studies, conducted by third parties, are used to assess the value of U.S. tax payers' investments in those programs. Since only measurable benefits are included, the studies provide conservative estimates of impact. Nevertheless, these studies indicate that the aggregate return from investment in NIST laboratory research programs is twice the return for private-sector innovations and ten times the average return on capital investment in the U.S.

Areas of Increasing Emphasis. In anticipation of an information revolution expected to rival industrial revolution in social impact, NIST is planning the establishment of a new Information Technology Laboratory whose mission is to develop and support measurement technologies, standards of interoperability, etc., in support of the National—and Global—Information Infrastructure.

A major component of the information revolution will be the continued evolution of semiconductor and magnetic storage devices. Existing technologies for production and characterization of these devices are approaching ultimate limits imposed by material properties and physical laws. NIST has established the National Semiconductor Metrology Program to address problems of fundamental metrology which must be solved in order for semiconductor industries to meet the demands of the 21st century.

As device miniaturization progresses toward 2015, we will soon need to build and characterize devices whose typical size is just a few atomic diameters. There currently are profound limitations to our ability to measure, fabricate, characterize, and understand atomic scale devices. NIST has begun a new nanotechnology initiative specifically to enhance our current capabilities to make and study nano-structured materials.

Because of very rapid advances in the field of biotechnology, the real industrial need for critical new measurements and standards is growing faster than are the underlying measurement technologies. To provide the infrastructural support to enable these technologies to grow, we have initiated a program in Biotechnology.

As social pressures increase to monitor or mediate the long term effects resulting from increasing environmental stress of the growing human population, it is essential to provide substantially improved measurement technologies with sufficient sensitivity, accuracy and reliability that definitive studies can be performed. Long-reaching policy decisions concerning use of precious resources must not be made on the basis of conflicting and inadequate experimental data. To address these crucial measurement needs, we have initiated a program in Environmental Technology.

Manufacturing Extension Partnership (MEP)

The MEP helps small and medium-sized companies succeed in the marketplace by helping them to improve their operations by adopting new technologies. These businesses typically lack the ability to absorb new manufacturing technologies straight from the lab into their operations.

There are more than 370,000 U.S. companies with fewer than 500 employees, accounting for about 95 percent of all U.S. manufacturing plants. These companies are assisted through MEP's growing nationwide network of affiliated manufacturing extension centers run by and built on local, state and non-profit groups that provide hands-on technical assistance to small manufacturers.

The MEP takes maximum advantage of programs already in place, avoiding duplication of efforts among existing technology assistance organizations; it concentrates on matching company needs to the best available help from the private sector, state, local or federal government, regardless of source. Company benefits from formal technical assistance from MEP extension centers total led $320 million between 1989 and 1992—a return of over $7 on each federal dollar invested.

Advanced Technology Program (ATP)

It is a rigorously competitive program which invests in cost-shared research by individual companies or industry-led joint ventures. The sole aim is to develop high-risk, potentially high-payoff enabling technologies that otherwise would not be pursued because of technical risks and other, obstacles that discourage private investment. These obstacles to private-sector investment include high technical risk, prohibitive cost, long pay-back horizons, or anticipated returns not specific to individual firms or distinct industrial sectors. The ATP is market-oriented. While government provides the catalyst—and in many cases, critical technical support—industry conceives, manages, and executes ATP projects. ATP support is strictly limited to pre-product development that is high risk, and ATP will not support any product development. Because of the risk involved, some projects will fail. Others may proceed faster than anticipated, and intermediate products may appear even before the project ends. But NIST only cost-shares on the R&D tasks. Whether the commercialization begins to take place before the ATP project ends or long after, the company must pay 100% for designing specific products incorporating the technology and any costs associated with commercialization.

Commercial firms know best how to commercialize a promising new technology. With this in mind, the ATP funds for-profit companies. Small, medium, and large companies, and joint ventures led by two or more companies, are eligible for direct funding. Successful ATP project sponsors range in size from start-up companies with a handful of employees to major industrial firms with international scope. Universities, federal laboratories and non-profit independent research organizations participate in many ATP projects, but as subcontractors or as members of joint ventures (non-profit independent research organizations may administer joint ventures). The ATP has a comprehensive plan for monitoring and evaluating its performance.

ATP project goals are clear they are expected to result in U.S. companies developing new product lines, hiring new employees, capturing more world market share, and prospering so that our economy grows faster, resulting in increased tax revenues.

NIST Quality Outreach Program

By the 1980s, it was clear to many industry and government leaders that a renewed emphasis on quality was no longer an option for American companies but a necessity for doing business in an ever growing world market. As a result, the Malcolm Baldrige National Quality Award was established by Congress in 1987 to promote quality awareness, to recognize quality achievements of U.S. companies, and to publicize successful quality strategies. The award is not for specific products or services. Two awards may be given annually in each of three categories: manufacturing, service, and small business. In conjunction with the private sector, the National Institute of Standards and Technology developed and manages the award program.

Businesses located in the United States may apply for the award. Those that do must undergo a rigorous evaluation by an independent board of examiners composed of private- and public-sector experts in quality. The examination includes onsite visits for those passing an initial screening. Each applicant receives a written summary of strengths and areas for improvement in quality management.

Seven broad categories make up the criteria: leadership, information and analysis, strategic planning, human resource development and management, process management, business results, and customer focus and satisfaction. Applicants for the award must provide data to show quality achievement and quality improvement in each area.

A General Accounting Office report calls the award criteria "the most widely accepted formal definition of what constitutes a total quality management company." Almost 1 million copies of the criteria have been distributed. Thousands of organizations use the criteria as a quality improvement "road map." In addition, about 30 states have established—or will establish soon—state quality awards programs, most of which are modeled after the Baldrige Award.

While quality management cannot guarantee success, the Baldrige award winning companies and many others believe that investing in quality can lead to outstanding returns, both for individual companies and the country. According to a recent report by the Conference Board, a private business membership organization, "A majority of large U.S. firms have used the criteria of the Malcolm Baldrige National Quality Award for self-improvement, and the evidence suggests a long-term link between use of the Baldrige criteria and improved business performance."

NATIONAL TECHNICAL INFORMATION SERVICE

Introduction.

The National Technical Information Service (NTIS) is a self-funded government agency under the Department of Commerce. For nearly 50 years, all of our costs associated with collecting and disseminating the Nation's collection of scientific, technical, engineering and business information are paid for by the sale of our products and services.

NTIS offers customers abroad range of information in different formats that is available no place else. Over 200 U.S. government agencies contribute about 12,000 documents per month to the NTIS collection. NTIS currently holds over 2.5 million documents in the collection. In 1992 Congress passed the American Technology Preeminence Act (ATPA) which mandates that all Federal agencies submit their public scientific, technical, engineering and related business information to NTIS. This has significantly increased the breadth and depth of our information products.

Fedworld

Fedworld is an on-line information service established by NTIS in 1992 to provide the general public with a user-friendly, central resource for government information. Fedworld provides both dial-up and Internet access. Today, there are over 120,000 registered users that access everything from White House press releases to the Security and Exchange Commissions' investment advisory's to the National Cancer Institute's Cancer research or treatment information.

In addition to the databases described above, Fedworld also allows users to "gateway" through the system to over 130 other publicly available government information systems. This effectively provides for a "one-stop" electronic shopping mall of numerous types of government information.

Automated Document Storage and Retrieval System (ADSTAR)

NTIS has moved into the electronic input, storage, and retrieval environment. Automated Document Storage and Retrieval (ADSTAR) is the information management system that will tie together the optical character readers and scanners with the full-text database systems, optical disk library-system, CD-ROM production system with the Fedworld data link and the remote printing capabilities.

At the present time, we have successfully implemented the concept to scan documents into the image storage system and retrieve them on demand. These documents can then be printed in paper, microfiche, or converted to character read material and formatted to meet customer needs—even custom CD-ROM's. This new system will be integrated order processing and billing systems and significantly improve our ability to satisfy customers and reduce costs.

Other NTIS Services

Fax Management (both inbound transmissions and outbound transmissions); Freedom of Information Act (FOIA) fulfillment; production services, patent licensing services, business partnerships and joint ventures are other services NTIS offers other government agencies. For nearly 50 years, NTIS has been the cost effective alternative to help federal agencies improve their own information activities.

THE BUREAU OF EXPORT ADMINISTRATION

Critical Technology Assessments

BXA is the departmental lead for conducting in-depth assessments on the financial status and production capabilities of industries and technologies critical to current and future defense systems. These assessments provide industry and government with comprehensive information and analysis on the performance and competitiveness of critical technology firms, an important function in light of declining defense budgets. While these technologies are essential to developing next generation defense systems, they are also dual-use in nature and crucial to our ability to compete in the global economy. Examples of recent assessments include artificial intelligence, advanced ceramics, advanced composites, superconductivity, and optoelectronics. Additional assessments are underway in semiconductors and software.

Competitive Enhancement Program

BXA is leading a unique interagency effort to enhance the competitiveness of specific subsectors that have been hurt by imports but are nonetheless vital to our economy. This program evaluates the strengths and weaknesses of targeted subsectors, introduces potential customers to manufacturers, and provides a comprehensive response to the specific needs of that subsector. BXA assembles teams of government experts and end-users to visit manufacturers and then to apply the expertise and resources of the team members to help the manufacturers facing competitive challenges.

To date, this interagency effort has addressed the competitive concerns of three electronics subsectors: semiconductor brazed pins, copper tungsten heat sinks, and aluminum silicon carbide. In the first two cases, domestic firms are facing foreign competitors with advantages in price, technology, or manufacturing capabilities. In the last case, the United States is in a position to take a leadership role in this emerging technology. BXA is reviewing additional subsectors.

Fostering Joint Technology Ventures with the Former Soviet Union

The Department of Commerce is also a catalyst in spurring technology relationships between U.S. industry, and defense establishments in the former Soviet Union (FSU) that will both enhance our competitiveness and assist economic conversion in those states.

The lack of market driven cost restraints has resulted in FSU research programs pursuing many technological paths of that were prohibitively expensive to western market-based economies. The results and knowledge base now provide the opportunity for exploring new commercial applications for this base of research and "know how."

The Bureau of Export Administration as Vice-Chair of the Defense Conversion Commissions with Russia, Ukraine, Kazakhstan, and Belarus, has taken a lead role in researching and disseminating to U.S. industry information on FSU technology.

In addition, BXA provides information on how to develop joint research relationships and referrals to appropriate U.S. agency programs for assistance in financing these ventures.

Economic Impact Analyses

Export controls on technologies that have both military and commercial applications can adversely affect U.S. industry, particularly high technology sectors, by excluding U.S. firms from certain markets. In response to the mandate of the Trade Policy Coordinating Committee, the Bureau of Export Administration developed a new initiative in October 1994 to analyze the impact of export controls on U.S. industry and to ensure that economic factors are considered in export control decisions. The goal of this program is to remove export controls that are not serving their intended security purposes and are hindering our competitiveness in world markets.

THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

National Information Infrastructure and Global Information Infrastructure

The Federal Government is acting as a catalyst to promote the private sector development of the NII and GII. The NII and GII will directly contribute to a stronger economy, more competitive business, more effective government, and better educational and technological leadership. NTIA is the agency within the Department of Commerce that supports the Secretary of Commerce as the principal telecommunications policy adviser to the President, and Vice President. In this capacity, DOC/NTIA provides administrative support on the planning and implementation of the Administration's NII/GII initiative. DOC/NTIA efforts are focused on:

- The *Telecommunications and Information Infrastructure Assistance Program (TIIAP)*, a competitive, merit-based program which provides matching grants to state and local governments, health care providers, schools and universities, libraries, community groups and other nonprofit entities to access new telecommunications and information technologies. TIIAP, which is administered by DOC/NTIA, received requests for more than $560 million in 1994. Secretary Brown announced 92 TIIAP grants totalling $24.4 million in government funding in October 1994. The TIIAP projects will demonstrate how NII can be used to create a technology-literate and creative work force ready to compete successfully in the 21st century.
- The *Information Infrastructure Task Force (IITF)*, formed by the White House and chaired by Secretary Brown, consists of high-level representatives of the Federal agencies that play a major role in the development and application of information and telecommunications technologies. The IITF articulates and implements the Administration's vision for the NII. NTIA provides administrative support and staff assistance for much of the work of the task force.
- The *U.S. Advisory Council on the NII (NIIAC)*, established by the President through Executive Order No. 12864, consists of thirty-seven members appointed by Secretary Brown to provide private and public sector consensus. advice to the Secretary on the development of the NII. The Council members represent many different stakeholders in the NII, including industry, labor, academic, public interest groups, and state and local government. NTIA provides administrative support for the Council.
- The *G–7 Telecommunications Ministerial in Brussels in February 1995* will advance the development of the GII as the foundation of the information society and provide an opportunity for private sector as well as governmental exchanges. The GII holds significant economic and social promise for all nations and, although the private sector will lead the development and implementation of the GII, such cooperation and collaboration among nations is essential. NTIA has the prime responsibility within the Department for the preparations for the G–7.

Telecommunications Legislation

The Administration supports passage of telecommunications reform legislation that will open markets to competition while including safeguards as necessary to protect the public interest. Successful legislation should promote competition, provide open access, ensure regulatory flexibility and preserve and enhance universal service to ensure that all Americans have access to the benefits of the NII. NTIA expects to work closely with Congress during the next session to develop a bipartisan bill to accomplish these goals.

Telecommunications Research

NTIA's Institute for Telecommunication Sciences (ITS) is the Nation's premier Federal telecommunications research facility. ITS is performing state-of-the-art telecommunications research and engineering to improve telecommunications system planning, design, and evaluation. Current efforts focus on personal communication services; broadband radio; and related wireless and wireline communication technologies. A key aspect of ITS agenda is centered on research and engineering studies to further applied knowledge of the radio frequency spectrum. The resulting spectrum use concepts and models will lead to more efficient industry and Government use of the radio frequency spectrum.

Radio Frequency Spectrum Analysis

NTIA manages the Federal government's use of the radio frequency spectrum. Program activities broadly address every aspect of radio frequency spectrum management, including authorizing government frequency assignments, providing in-depth technical engineering analyses of spectrum use to promote increased sharing of spectrum resources and spectrum efficiency, supporting domestic and international policy development and long-range planning, establishing plans and policies that ensure the efficient, effective and equitable use of the spectrum, and representing the U.S. government position at international conferences, technical study groups, and standards bodies.

THE PATENT AND TRADEMARK OFFICE

Administration of the Patent and Trademark Laws

The PTO has been at the forefront of the Administration's efforts to improve U.S. competitiveness in the international marketplace by stimulating the technological capabilities that bear on economic growth. At the heart of technological-based economic growth are America's innovators. The PTO provides an invaluable link between America's innovators and a technology-based economy. The PTO serves America's inventors and entrepreneurs by providing them with the protection and encouragement they need to turn their inventive ideas into marketplace realities. The PTO accomplishes this by administering the laws relating to patents and trademarks, which includes issuing patents, registering trademarks and disseminating patent and trademark information to the public. Innovative activities appear to be at an all time high. This is evidenced by the record number of patent and trademark applications filed and the record number of patents issued this past fiscal year.

Dissemination of Technology to Stimulate Innovation

At the root of innovation is information dissemination. The PTO promotes innovation by widely disseminating patent and trademark information throughout the world. Not only does the PTO publish patent and trademark information weekly, but it also supplies the public with patent and trademark information through its 78 depository libraries located throughout the country and its automated systems in its Public Search Rooms located in Arlington, VA.

The PTO also relies on the private sector to disseminate patent and trademark information. The PTO "wholesales" data on a marginal cost basis in the form of our data base tapes to private sector firms. This allows private sector companies to provide value-added services to the public by enhancing and repackaging the data and making search systems available through commercial networks.

The PTO has made the full text and images of about 1,500 AIDS-related patents available to the public. This AIDS-related patents data base represent a huge leap in making patented technology available to the public. It not only spurs the research community to create methods of curing and controlling AIDS, but also demonstrates the potential of the use of patents as a tool for promoting technology and education.

New Examination Guidelines

The PTO is taking aggressive steps to address the concerns of one of the most important patent user communities—the biotechnology industry. One of the recent significant steps taken by the PTO is the proposal of new guidelines for examiners to follow when reviewing patent applications for compliance with the utility requirement of 35 U.S.C. 101. The proposed guidelines should prevent the "catch-22" complained of by many biotechnology companies, whereby a company is required by the PTO to provide human clinical data to support therapeutic utility while at the same time that company is unable to raise funds to perform the trials that generate the clinical data because the status of the patent application is unclear. The proposed guidelines will also address several other problems identified by the biotechnology industry.

Future Patent Reforms

The PTO will continue its efforts to improve domestic and international levels of intellectual property protection and promote industrial and technological progress in the United States. The PTO will work with Congress to implement legislative reforms that will make the patent and trademark systems work better and provide more effective rights. Such legislation would speed innovation by making technology, especially foreign technology, available to the public at an earlier date. In addition to Congressional initiatives to reform patent and trademark practices, the PTO, with assistance from the public through public hearings, will continue to review its operating procedures and change any procedures that prove to be burdensome, inefficient or outmoded. Doing so will enable the PTO to provide U.S. businesses with one of the most important competitive tools they need to compete in today's market—adequate and effective intellectual property rights.

THE OFFICE OF AIR & SPACE COMMERCIALIZATION INTRODUCTION

Introduction

The Office of Air & Space Commercialization (OASC) advises the Secretary and Deputy Secretary in the formulation and implementation of policies which foster the growth and international competitiveness of the U.S. commercial space sector, and which promote the commercial use of space by U.S. private industry.

Remote Sensing

In March Deputy Secretary Barram, on behalf of the Administration, announced a major policy change in the treatment of commercial remote sensing imagery and systems. The U.S. Policy on Foreign Access to Remote Sensing Space Capabilities (PDD NSC–23) anticipates expanded sales of commercial images from space and a new market for the export of remote sensing systems themselves.

This policy represents a major milestone in the commercialization of space-based imagery and unleashes the potential of a critical 21st century information technology at a time when the international market for space-based imagery appears poised far significant expansion. It should open the way for U.S. aerospace firms to aggressively compete in a $400 million market worldwide, a market which could grow to more than $2 billion by the year 2000. The geographic information systems market (which is the market for images incorporating demographic or technical data with digital maps) could be in the range of $5 to $15 billion by the turn of the century.

The commercial remote sensing policy also aids the defense industry in its efforts to find new commercial applications for defense technologies. Moreover, the data produced by this technology will include environmental and geographic information that will greatly advance emergency management and rescue, disaster relief, mineral exploration, crop management, cartography, real estate and a variety of other commercial endeavors and become an important product to be delivered over this country's National information infrastructure.

OASC will continue to foster the U.S. technological lead in this area into the 21st century, encouraging the worldwide exploitation of 1-meter imagery by aiding in the implementation and refinement of this policy in the coming years. It will be responsible for representing private sector interests while considering national security and foreign policy concerns in interagency and intergovernmental policy discussions.

Space Launch Trade Agreements

OASC, on behalf of the Department, has worked with the rest of the U.S. government and other nations to help increase the size of the world market for space launch without jeopardizing economic advantages that the United States has gained.

Launch-service trade agreements developed with the governments of Russia and China strive for an environment under which introduction of launch vehicles from economies in transition will cause minimal economic disruption. These agreements will allow U.S. launch service providers to compete fairly with foreign providers for international business, and aid the transition of formerly non-market economies to economies based on fair and even trade.

As we reach the turn of the century, OASC will be involved in the maintenance of the agreements already signed, as well as in negotiating possible new agreements with other non-market foreign launch providers. The office views these agreements as an integral part of the Administration's plan to develop low-cost, dual use, reliable access to space and foster fair competition in the international launch market.

National Space Launch Policy

OASC has begun exploring new and innovative relationships between government and the private sector in the area of space launch.

A new Presidential policy on space transportation (U.S. National Space Transportation Policy, NSTC–4) recognizes the importance of private sector input into government space launch policies and activities. This policy reflects a paradigm shift toward supporting increased commercial activity in space, therefore encouraging growth in satellite manufacturing, launch services, and space applications, and reducing the cost of access to space.

In response to this policy, OASC organized a Government-Industry Roundtable of 25 CEO's from the launch, satellite manufacturing and satellite operating community. The intent of the meeting was to listen to private-sector concerns and suggestions for developing an overall strategy on how to help make this industry more internationally competitive.

As a result of this meeting, OASC and the Department of Transportation's Office of Commercial Space Transportation are developing a policy implementation plan that spells out specific means of promoting the international competitiveness of our space transportation sector. With industry, NASA, the Department of Defense, and the Congress, the two offices will examine the role of the private sector in the design, financing and development of U.S. next generation launch systems. They will also explore innovative industry-government arrangements for new space transportation systems (Ex., risk sharing, tax incentives, equity participation).

Emerging Space Applications

OASC is keeping an eye on the future of space by supporting the development of unique and innovative commercial activities in space. OASC's plans include investigating ways to remove impediments to a privately-financed, next generation commercial space-based production facility. The office is consulting with private Global Positioning System equipment manufacturers to examine the application of GPS technology to the National and Global information infrastructure and the every day utility of accurate, world-wide position information. OASC is also examining the role of satellites and wireless communication in the GII.

Senator BURNS. Thank you, Mr. Secretary. And we appreciate you being here.

Before we start the questioning, Senator Kerry, do you have an opening statement? Would you like to make one or summarize it, and then we will start in with the questions?

STATEMENT OF SENATOR KERRY

Senator KERRY. I would just like to say that we are at a critical point and I am sure Senator Rockefeller said some of this and I hope other colleagues have and the Secretary certainly has embraced it as a component of his testimony, which I welcome. But I think as we go about this process of considering the fiscal crisis we are under, it is not just true in this sector, but in other sectors also. For example, we had a hearing in this committee the other day on the issue of Amtrak and rail stock investment.

And we are really at a critical moment in this country, where we have got to stop and think hard about the relationship between the investments we make today and what we get in the future. The reality is that much of the science on which there was huge Federal expenditure in the 1950's and 1960's is really only reaching its full measure of commercial viability and use today.

Whether it is digital technology or a whole set of other technologies that were designed specifically for an entirely Government-supported program or endeavor, those now have huge commercial application, and they are the reason that whole components of our brainpower/technology industry are in a terrific comeback or in the lead.

And as we go through the questioning here, and as we look at this relationship, we really have to try to separate some of the ideology from the practical impact of these investments.

And the second point I would make—and the Secretary partly touched on it, but I want to underscore it—not one of our competitors is contemplating moving in the direction that is being put on the table by some folks nowadays. Not one. Not one competitor would do anything except laugh and joyously walk to the bank at this debate in the United States today.

They have to be scratching their head and saying, "Thank God the Americans are confused as they usually appear to be." Because what we are doing—he has called it unilateral disarmament—is basically saying, OK, you guys go ahead and practice your form of capitalism and we are going to stay here and be the prisoners of some kind of ideological purity that has no relationship to the marketplace.

And that is what this debate is all about. And I hope we are going to just stop and take stock and recognize that if you do not have basic research, if your universities are not able to do things that no business or no venture capitalists will fund because of the cost—and all you have to do is look at what is happening with venture capital today and biotechnology, and you can begin to see that—we are not going to stay in the lead, and we are not going to put our people to work.

Because we are sure as hell not going to put our people to work unless we go back to Third World status, sewing shoes and doing leather and the other things that have moved now not only from South Carolina, where they once were in Lowell, Massachusetts, but they have moved now from Taiwan to China and elsewhere because every low market has found them racing off to the next lower-cost place.

So I thank you for the chance to say that. This is a very important hearing, and I am glad we are having it.

Senator BURNS. Thank you, Senator Kerry.

In consideration of the time, Senator Stevens has another hearing to go to and is involved in, I will waive my right and recognize Senator Stevens.

Senator STEVENS. Thank you, Mr. Chairman.

I just have one question. And, Mr. Secretary, it is very provincial. Now, 70 percent of all the fish harvested in the United States is harvested off of Alaska. And according to the latest figures I have seen, we have, in Alaska, 173 employees of the National Marine Fisheries Service, 6 percent of the employees. And 5.5 percent of the total budget of the National Marine Fisheries Service are spent relative to Alaska fish in Alaska.

I have inquired of you some time ago—and I know there has been a transition going on for all of us—about the plans we hear to reduce the full-time equivalent employees in Alaska substantially more than anywhere else in the country. The FTE reduction hits Alaska percentage-wise higher than anywhere else.

I have come over to ask you if you will take a look at that. I know Dr. Baker is coming on, but I do have another hearing. And I appreciated the conversation we had yesterday. I did not have these figures in hand yesterday, but I was reminded of the letter I had written to you about this.

If anything, if we are going to reshuffle the employees, I would hope there would be more coming to the place that is producing the bulk of the fish for the United States now. As a matter of fact, we have the largest fish landing port in the world in Dutch Harbor, the second-largest in the United States in Kodiak. We have a substantial, ongoing fishery.

And when I look at your charts, Mr. Secretary, I notice that there are blanks there when it comes to partnerships and there are blanks there when it comes to these FTE expenditures. The one area where we do contribute and need the most help is in fisheries.

Can I ask you just a simple question, if you will go back and take a look at that letter and see if you can give me some idea of why the plan is going to hit Alaska so hard?

Secretary BROWN. Well, I would be glad to do that, Senator.

As you know, I very much respect the leadership that you have given in this area. As we discussed yesterday, we support your S. 39, the Reauthorization of the Magnuson Act. We believe that the positions that you have taken in that regard are sound.

Your fishery is producing so much because it has been a very well managed fishery, very responsibly managed. I will assure that Alaska is not disproportionally affected by any FTE reductions that might be recommended.

And let me assure you today, if I could, Senator, without even going back to the office, that we do not expect any dislocations in fiscal year 1995. I recently received additional buyout authority from OMB, which should help deal with that issue.

We do have an FTE problem, as you know. We have made a commitment to the American people to reduce the Federal work force. I want to make sure, as we do it, that the distribution of those reductions is fair and equitable, and that no State—particularly a State that has performed so well in managing its environment—is negatively impacted.

Senator STEVENS. Well, I am particularly concerned with the jurisdiction of this committee, in terms of science and technology. We have a new plan for an increased presence in Juneau, to assist Dr. Baker's people. I would hope that as we look at these reductions, the whole concept of taking some of the science and technology closer to the area where the industry will prevail in Alaska also.

Thank you very much, Mr. Chairman.

Secretary BROWN. Thank you, Senator.

Senator BURNS. Thank you, Senator Stevens.

This morning, Mr. Secretary, you went over your charge and the policy of this administration and the approach it takes in its support of private industry.

Last year, most of the debate around S. 4 dealt with what is the policy of the Government and in the private sector, as far as funding R&D projects and product markets—and last year, particularly with the ATP program, that has grown in funding as your figures would indicate.

How do you respond to the criticism that the ATP program does pick winners and losers? Or, in your view, does it pick winners and losers in commerce?

Secretary BROWN. I would respond very simply, Mr. Chairman. It does not pick winners and losers as I indicated both in my oral statement and my written testimony. That is just a false charge.

The program is bottom-up. It is private-sector driven. It is peer reviewed. It is the precommercial phase of developing new technologies. It has nothing to do with product development where you could be charged with winners and losers. There is nothing here that picks winners and losers.

What we do is open up whole new sectors of our economy. We provide the opportunity to increase competition using new technology to take what we learn in basic science and make sure that it is American technicians and American manufacturers that then can produce those products, that can create jobs and growth in America.

So, there is nothing in the program related to picking winners and losers. I know that is a charge often made and I would respectfully ask those who make it to demonstrate where it happens. It does not happen.

Senator BURNS. The Japanese Government practices an aggressive industrial policy where government virtually dictates the policies of its various industries. Sometimes that approach has worked, as in the case of VCR's. However, sometimes it has not.

A case in point is the area of high-definition television. The Japanese industry invested heavily in analog systems, but they were made pretty obsolete pretty fast by the introduction of digital.

And now with another new digital system, the new technology, even in digital, the new generation, analog, of course, is just the wagon of the past.

In your view, what are the advantages or disadvantages of the Japanese approach, and how does it compare with the current U.S. technology policy?

Secretary BROWN. We have an approach, Mr. Chairman, that is uniquely American. It is created to make us productive and competitive. It does not copy anyone else's approach.

I would submit that it is not industrial policy, although every time we get into a debate I find that folks who are charging that something who are industrial policy—I ask each of them what it is, and they all have a different definition of what it is.

I think it is time, Mr. Chairman, to move beyond what I consider to be an ideological, a philosophical debate, and talk about what is in the best long-term economic interest of the United States, how Government and business, how the public and private sector can work together.

I believe we have been paralyzed by that debate in the United States for several decades. While we have been trying to figure out the relationship between the Government and the private sector, our international competitors figured it out a long time ago. And that is why they are doing much better than they ought to be doing in the global competitive environment in which we all have to compete, and we are not yet doing as well as we should be doing.

I am for taking a bottom line approach, Mr. Chairman, a practical, pragmatic approach. How do we make the United States more productive and more competitive?

I would submit, Mr. Chairman, that the only way to do that in this present globally competitive environment is to have a relationship between the public and private sector, clearly with the private sector in the lead. It is the private sector that rightfully fuels the engine that pulls the train of economic growth and job creation in America. But we, in Government, need to be better and more effective partners.

How can we help? There are a couple ways to help. One way is to get out of the way when we are in the way, and we have tried to do that the way we have dealt with the issue of export controls, for example. We need a new Export Administration Act to take that further. The cold war is over. We need to start acting like it is over and stop paralyzing American manufacturers and their ability to compete in the global marketplace.

The other way is to stand shoulder-to-shoulder with American business and industry as we have been trying to do both in terms of technology and in terms of trade and export promotion, to say we are here to help you. We do not only want to have American business and industry compete, we want you to win.

We are tired of the era where we send American business people overseas and we say, good luck, we wish you well, let us know how you made out when you get back. That is not good enough anymore.

We are going with them. We are standing shoulder-to-shoulder with them. We are advocating their interests. We are doing it in trade policy, in export promotion policy, and in technology policy, and that makes sense.

Senator BURNS. Just a followup question. Since 1990, $10 million were in the ATP program in 1990. Now it has gone to over $400 million.

In a time, as Senator Kerry has indicated in his opening statement, of some concern, of Government that is trying to deal with deficits and trying to do something about slowing the national debt, has the Commerce Department, has NIST taken a look at this and said, OK, there are some areas where we can cut, and maybe for us to set some priorities there before we start down this road into the Appropriations Committee?

Secretary BROWN. Well, Mr. Chairman, I would say respectfully that you are speaking to a member of the administration that has done something about the deficit, almost $700 billion in deficit reduction over a 5-year period. We have been very serious about not just talking about deficit reduction but doing something about it.

We have also established some priorities, looking to the short-term and the long-term. What does it take to keep America first rate as far as our economic clout in the world, to keep us on the cutting edge technologically?

We made a decision that even in times of cutting back in almost every area of Government, if we were interested in the long-term competitiveness of America we had to beef up our support for civilian technology.

Yes, we made a commitment to take NIST from $400 billion in 1992 to $1.4 billion in 1997—a very calculated decision and representing a very small part of the Federal Government because we honestly believe, Mr. Chairman, that this is the only way to protect America's economic future, to invest in manufacturing technology centers, to get technology in the hands of small and medium-sized businesses, to support programs like the ATP program so we can stay on the cutting edge technologically. We think that that is an investment in our future, Mr. Chairman.

Senator BURNS. Senator Rockefeller?

Senator ROCKEFELLER. Thank you, Mr. Chairman. Mr. Secretary, when questions were being raised about the Advanced Technology Program and the so-called picking of winners and losers, as I understand it first of all you have got a situation where corporations are now downsizing, basic research is being cut back even by larger corporations, so there is a tremendous pressure for short-term results and, therefore, the kind of research and development which leads to short-term results. And then they say, well, it is winners and losers.

As I understand it, there is merit review of all proposals. All of the ATP is deliberately industry led. Industry makes all the decisions just as in the venture capital matter that we worked on last year. Part of Commerce and Small Business Administration reached an agreement on that proposal. Industry makes the decisions. Yes, there is some Government participation, but industry led; industry makes the decisions.

All of these projects are only for a certain number of years. They have a stop date on them. And, you know, they are all cycled through a competitive process.

So, in terms of need for these programs, especially the Advanced Technology Program and the manufacturing extension centers, which I think are at the core of a lot of this, please again say more about why both small and large firms have trouble finding funding for long-term research. Again, I am dividing between short-term and long-term.

As John Kerry said a moment ago, the work of the fifties and sixties is now paying off in the nineties. The long-term research is absolutely the key to our future. Why are they having such a hard time getting money for this, for those who say just turn to the market?

Secretary BROWN. Well, you have said it best, Senator Rockefeller. The fact is that companies that were spending 8 percent on R&D, 7, 8, 9 years ago are now spending zero. It is because of the new competitive global economic environment. They just cannot afford to do it anymore, and so they are not putting money into anything but things that have short-term turnaround time.

The product development cycles are much shorter. The ones that used to be 7 or 8 years are 18 months from conception to obsolescence.

So, if they are going to stay alive they have got to put money into that which is short-term and ignore the long-term, and that is the gap that these programs are filling, just the gap that is not being filled by the private sector. That is why they are so absolutely essential to our economic future.

We all know the kinds of funding that venture capitalists provide. They provide the kind of funding where a product can be developed quickly, there can be a quick turnaround, and therefore a relatively quick profit. They do not fund the things that are going to be profitable 8 or 10 or 15 or 20 years down the road as you pointed out in your opening statement, Senator Rockefeller.

Many of the advantages that we are seeing now, that help our competitiveness, are based on investments in basic science and technology and basic research that took place in the fifties and sixties, and we are just bearing the fruit. That is nothing that we could have raised money for in the private capital markets.

Senator ROCKEFELLER. Let me switch to the manufacturing extension centers because people hear those words and their eyes glaze over, but they are fundamental.

There are 360,000 small businesses in this country which manufacture, not just small businesses but businesses which manufacture. Is it not the case that they are substantially lagging behind others comparable in other countries in their ability to get to technology, and thus the whole purpose of the manufacturing extension in the center in the first place?

Secretary BROWN. There is no question about that, Senator, and I would compare it if I might to our agricultural extension program at the early part of this century. The reason we are now the breadbasket of the world is because there was a public-private partnership because the Federal Government understood what it would take to compete in the future.

You are absolutely right in that our small manufacturers are lagging way behind. We are trying to close that gap. You close that gap by giving them new technology. It does not have to be high technology, just new technology so that they can continue to manufacture competitive products—competitive as far as quality and competitive as far as cost. And that is exactly the role that our manufacturing extension center program is filling.

Senator ROCKEFELLER. Mr. Secretary, a third and final question. It has been pointed out by many this morning that the Europeans and the Asians are not stopping. We may be, but they are not. To wit, the European Union's new industrial technology program, as I understand it, they call it the Fourth Framework Program, as a union, as a collection of nations, is $14.4 billion over 4 years in addition to what the individual countries are doing on their own.

So, I mean, that is in effect what we are up against. And, of course, Japan, South Korea, Singapore, the rest of them, Taiwan, are doing what we know they are doing.

Now, people say, well, OK, that is fine but you can get at this through tax cuts or tax credits, capital gains, whatever. And what I would like to have you make, if you could, is the distinction between what you get from a tax credit or a tax cut alternative as it relates to the long-term or the short-term vis-a-vis what we are talking about here, a specific long-term pay off investment policy through ATP and the manufacturing extensions. In other words, is it apples and oranges?

Secretary BROWN. First of all Senator Rockefeller, as you well know the tax cut approach is a much more expensive approach than the ATP kind of approach. Second, it is not a target approach. But the two are not mutually exclusive.

The administration in the past has supported the R&D tax credit. We hope that in the context of changes in the tax code generally we would have the opportunity to do that again.

Senator ROCKEFELLER. People are talking beyond the research and development tax credit, though. They are talking about a tax cut in general.

Secretary BROWN. That is right, and that is why I started by saying, Senator Rockefeller, that that is a much less targeted, I think much less effective, and much more expensive way to do what the kind of program we are talking about today does.

This is a very targeted approach. This is an approach that is very specific.

Senator ROCKEFELLER. Once again the tax cut—and then I will stop, and I apologize to my Chairman. But if it is a tax cut, by definition, according to the rules of the market today, it has to go into the short-term payoff product. By definition it cannot be for the longer term.

Secretary BROWN. That is exactly right. That is what makes it different, and that is why I said the two are not mutually exclusive. They can be companion measures. One might do some good on the short-term. The other one clearly does good on the long-term.

Senator ROCKEFELLER. Thank you. Thank you, Mr. Chairman.

Senator BURNS. Senator Kerry?

Senator KERRY. Thank you, Mr. Chairman. Mr. Secretary, first of all I would like to say that I really want to salute your stewardship of the Department. You have done a superb job of making this an active Department which is making its presence felt in very vital ways, to extend American presence and influence in the marketplace, and I think it has really set a standard for the Department.

One of the things that you know, and this is another sort of penny wise, pound foolish issue is another subject slightly outside of the parameter of the two here, but I want to take advantage of your presence here.

You know, since we have talked about it privately, that I have been a passionate advocate of business centers, American business centers. We authorized and appropriated money for the Japan one. I guess we are opening one now in Indonesia. But it seems to be moving very slowly compared to the return.

When I was in Hong Kong recently, the Foreign Commercial Service people there said to me that we are missing out on literally hundreds of millions of dollars of contracts. We simply do not have the people here to do all of the connecting. And if we had a business center there are many small businesses and medium-sized businesses that could avail themselves of the center, of the presence of the services, and we would be able to return that investment hundreds of times over to the American taxpayer.

Now, this is obvious. You know it. I know it. They know it.

It also would give us a very important presence. I mean, I continually hear from business people in Asia particularly, you guys do not seem to be here in the same way as other countries are. There is not the same kind of presence, and this would enhance that presence.

You were recently in both China and Delhi; we were almost there at the same time in both places, and I know you have heard this. Why are we not pressing this harder? Why are we not just finding the money and setting up a seven city cycle and going at this full speed?

Secretary BROWN. Well first, as I think you know, Senator, I could not agree with you more. We have established as part of our national export strategy something called our big emerging markets that we are focusing on; these 10 markets around the world that we think have great promise for the future as far as the commercial interests of the United States.

There are four of those in Asia, China, India, Indonesia, and South Korea. There are two in Europe, Turkey and Poland, one in Africa, South Africa, and three in South America, Argentina, Brazil, and Mexico.

We intend to have those commercial centers open and operating in at least all of those markets. I personally opened one in Indonesia. I opened one in Sao Paulo, Brazil, one in Shanghai, so we are moving in that direction.

We are not moving as fast as I would like to, and it is because of the budget constraints. I think it is important that we have a home away from home for American entrepreneurs, for businessmen and women to help them to do business overseas.

We particularly want to help small and medium-sized business who need more than just advocacy. They need a little handholding to move through the process. We need to beef up our United States Foreign and Commercial Service and we are trying to find ways to do that within out present constraints, even reassigning folks from markets that looked good 10 years ago but are not quite as promising as some of the new ones that you mentioned.

Senator KERRY. I know you are a passionate advocate of it, but it seems to me that this is such a clear revenue gainer.

Secretary BROWN. And it is leveraged Federal resources.

Senator KERRY. It ought to be a de minimis, quote, budget issue. Now, I know you are fighting some of this on the budget side, but I think we need to make a larger public issue out of it since it really is jobs and revenue. It is local revenue, State revenue, Federal revenue, and it just does not make sense not to be doing it more aggressively.

Secretary BROWN. Well, as I say, I think you are right, Senator Kerry. I think we have got to make the connection so that people understand that there is a simple equation, and that equation is American exports equal American jobs. It is that simple. Every billion dollar increase in exports means somewhere between 17- and 20,000 new jobs for the American people.

So, this is not just some academic exercise. The dollars that we spend on export promotion relate directly to our ability to grow this economy and create high-wage, high-quality jobs for the American people.

Senator KERRY. Mr. Secretary, last Friday there was a front page article in the New York Times regarding global warming, suggesting that it resumed again in 1994, and the climate data support that. One of the issues on the table today is the global change research programs budget. Again it is spending related as so much is today. But in 1990 Senator Gore, Senator Hollings, and I and others joined together to pass the Global Change Research Act, which was an effort to bring together all of the departments, NOAA, NASA, EPA, et cetera, to coordinate a comprehensive process of getting information in order to make smart decisions, scientifically based decisions about the environment and so forth.

Now suddenly there is new talk, in this new climate of downsizing, to suggest that that program—it passed the Senate, incidentally, 100 to nothing—is a politically driven program rather than scientifically driven and ought to be cut.

Would you comment on that and tell us perhaps for the record why the Government ought to be involved in this particular research?

Secretary BROWN. I do not know who else is going to do it, Senator. I think it would be a mistake to have cuts in that program. It has had broad bipartisan support. It is in fact a partnership with the university community, and it conducts basic scientific research geared toward documenting, understanding, and predicting changes in the physical and climate system through observations and analytical studies.

It is the kind of thing that brings the university community, agencies of the Federal Government, everybody together moving in the same direction with a common sense of mission and purpose.

We often talk about who else can do things. How can we privatize, for example. There are certain things that certainly ought to be privatized.

This is one that I think Government does a good job of, working with the private sector through the university community, and I would hope that there would not be cuts, certainly cuts of a significant nature in that effort.

Senator KERRY. Would you say that it is adequately funded now to do the research level that we ought to be doing, given the scientific questions still outstanding?

Secretary BROWN. We are struggling along, Senator Kerry. Fortunately, we have got terrific leadership. Dr. Jim Baker I think has done a wonderful job running NOAA, and I think it is that leadership that has really focused on how we better use resources, how we get the biggest bang for the buck, so to speak.

So, obviously, I wish that we had more to work with. But we understand in these times of budget restraints that we have got to do better with what we have got. And I think for now we believe that we can do a good job, an adequate job with what we have. We certainly would not want to see cuts in that program.

Senator KERRY. I see that my time is up. Mr. Chairman, I have to go to another hearing on Mexico. If we could leave the record open for possible additional questions I would appreciate it.

Senator BURNS. The record will remain open, Senator Kerry, and we thank you.

Senator BURNS. Mr. Secretary, I just have a couple more questions. Going back to your statement awhile ago where we see corporations, both small and big, who used to budget anywhere from 7 to 8 percent of their overall budget to R&D are not doing it now. And we know that Government policy sometimes changes the behavior and actions through tax policy or whatever, behaviors change.

I am wondering if they think, well, if the Federal Government is going to fund R&D, then we can take those resources and put them somewhere else. Or, what is your attitude if the Federal Government was not even in the business of funding R&D. Would they go back and reestablish or restore those funds for R&D just to ensure their own survival?

Secretary BROWN. Well, I do not believe so, Mr. Chairman. I think some of them would be out of business 4 or 5 years from now. They certainly would not be competitive.

I think what we are seeing is a response to the globalization of the marketplace and the smaller margins that exist in most of these highly competitive businesses.

I cannot believe that the relatively small amount of money that we are talking about—you made reference to the amount of the whole NIST budget in your opening remarks. That could not be the incentive for all the companies in America having those kinds of dramatic cutbacks in R&D spending. I mean, we are talking about somewhere between 1 and 2 percent of all Federal R&D for the kinds of programs that I have made reference to.

Senator BURNS. Also, I understand the administration's goal is to increase its current numbers of manufacturing technology centers, and smaller efforts from 44 to 100 by 1997. I think that is in your plans.

If this is true, how do you decide? What criteria are used in placing those new centers where they should be located, and what are the strengths and weaknesses of the current network of manufacturing technology centers?

Secretary BROWN. Well, we try to place them, Mr. Chairman, in proximity to where there are manufacturers, where people are actually engaged in manufacturing, and to place them in a way that they are connected with or can be connected with those manufacturers.

We would like to get good geographic spread. We would like to have good spread between rural and urban America. We do not want centers just on the east coast and just on the west coast. They need to be all over America.

We have mapped out our future plans. We would be glad to share that with you. We think it has been done after a lot of very sensible analysis as to where we can have the greatest impact, but I am very sensitive to the concerns that you expressed and those that Senator Pressler expressed, to make sure that we deal with the needs of rural manufacturers as well.

Senator BURNS. Some would argue the most effective way for the Federal Government to enhance our ability to compete is through measures that do not require a lot of taxpayer dollars. And you were stating a while ago maybe the tax incentives are probably more expensive than the program that we are on now. I find that interesting.

But some would say deregulation, antitrust, product liability, vigorous enforcement of existing trade agreements—do you agree with that assessment?

Secretary BROWN. All of those ought to be looked at. I think we are at stage in our development, in looking to the future and attempting to be more globally competitive, where we need to look at all of those things, Mr. Chairman.

Senator BURNS. With the new technologies coming down, and of course the location of your centers, your manufacturing technology centers, I have always held the view that as long as our technology continues and our telecommunications, that States like South Dakota and States like Montana in rural America can participate because the ability to move and exchange information is much greater now than it ever has been, and I would say that the information highway that has been talked about all over this country is playing a big role in that.

Have you centered any attention to this technology?

Secretary BROWN. Yes, we have, Mr. Chairman, and I know of your longstanding interest in telecommunications matters. We have had the chance to discuss them before.

We have some basic principles that we are pursuing. One is we want to encourage investment. It is very important. This information superhighway is going to be built by the private sector, not by Government.

Second, we want to encourage competition. Competition is good for the consumers. Higher quality, good products and services, lower prices.

Third, we want to encourage interoperability so that when we build these networks all over America we want to make sure they fit together, that they can be connected.

And fourth, we want to encourage universal service. We do not want to create a society of information have's and information have-not's with this new technology. We want to use telecommunications technology to close gaps that exist in America, whether they are gaps in delivery of health care services—I was at Fairfax Hospital a couple of months ago with Senator Rockefeller being involved in a demonstration of providing health care services, diagnostic services, to a rural West Virginia community using the best technology at Fairfax Hospital. It is unbelievable what can be done.

It ought to be done in delivering educational services. I was at a school in Harlem a couple of months ago, not far from where I grew up, where I saw the enthusiasm of young junior high school kids, who did not used to come to school, who now come early and stay late; of a faculty and a principal that come in over the weekend to put the wiring in so that these desktop computers can be installed.

And I saw the interest in, and thirst for, knowledge that these kids developed. And so these are all things that telecommunications technology needs to be used for.

And the way that you described it, Mr. Chairman, we participated in—I chaired a United Nations conference in Columbus, Ohio in December where the focus was on how we can get small and medium sized businesses into the export marketplace without them ever having to leave home, so they can do it by the use of telecommunications technology from wherever they are in America, which speaks to the opportunity that you presented.

So, all of those things are things that we are exploring.

Senator BURNS. Over in another area, and my time is up, but because of our agricultural industry, and that is what pays the bills in Montana, I still have got a strong interest in the National Weather Service's ongoing modernization effort.

In your own words, in general the modernization effort—is it still on schedule and to be completed by the end of this decade?

Secretary BROWN. It is, Senator. We are pleased with it. Whenever you move to a new system it is never without some glitches.

Again, I think it has been managed very well by Jim Baker and his colleagues at NOAA, and we are on schedule.

Senator BURNS. And in your own words, improvement in the system—are there definite improvements? Give us an idea on how this system is going to be better than the old system?

Secretary BROWN. Well, it is a way that we use technology to provide better services. As you know, Mr. Chairman, it is incumbent upon me to certify before the old system is taken out that there is no degradation in service so we assure America that there will be an improvement by that process.

Senator BURNS. Those are all the questions that I have for the Secretary. Do you have more questions?

Senator ROCKEFELLER. Yes.

Senator BURNS. Senator Rockefeller.

Senator ROCKEFELLER. One quick question and two observations. What saddens me, Mr. Secretary—and I happen to think that you are the best Secretary of Commerce we have had during my lifetime, which extends longer than your lifetime so that is a compliment.

Secretary BROWN. Not by much. [Laughter.]

Senator ROCKEFELLER. The great sadness about this whole thing is that words like ATP and MEC are acronyms and do not mean a lot, that we have two members of the U.S. Senate here and we had only a maximum of five. Yet, I do not think that Chairman Burns will call a more important hearing during the course of the next couple of years than this one.

People just do not know what we could lose; that if these programs were to die because of philosophical or ideological pressures that we go back to the short-term, and America goes back into the soup comparatively once again.

Our economy has grown now very substantially and very well, but it is not going to keep growing. You know, we are not going to keep this 4 percent business going. Some people are thinking that we will have another year and then maybe it will start to drop off again.

I think that the ignorance about what the Advanced Technology Program means, the fact that it is not picking winners and losers, that it is run through a process that is simply done on the merits, that it is industry led, that it is not Government led, that it is not Ron Brown picked, that these facts do not get through and, therefore, people who are ideological say let us just destroy this because it picks winners and losers. Nobody comes up and fights them, or at least on a mass scale, because most people do not know what we are talking about because these are both relatively new—ATP started in 1988 with President Bush—and they do not know.

So, I would just say strongly that I think that members of the Senate have an obligation to understand what the Advanced Technology Program means, what manufacturing extension centers mean, what that meant to a small community in West Virginia when they took 28 jobs away from the Swedes and put it into the hands of our people that have the highest unemployment rate in the Nation. That is observation No. 1.

And observation No. 2 is nobody knows what the U.S. Foreign and Commercial Service is. But let me put it to you in terms which if people did they would fight to keep the program.

I spent a lot of time in Japan. I went to school in Japan, spoke the language, and I have gone to Japan every year, usually twice a year. This year I took with me 38 West Virginians from 20 different business. We worked with your Department and Lauri Fitz–Pegado's U.S. and Foreign Commercial Service, and they did a job in matching up the particular types of industries that we were taking, virtually all of them small. One of them had two employees, one of them had six. You know, I would say 10 or 15 or 20 was the average. Yes, we had a couple of big ones.

And they went over to Japan. We went over to Taiwan. And we were so well matched up, and the work had been so well done, that when we returned half of the businesses that went over came back with contracts, or contracts-about-to-be, which is by definition impossible when you go to Japan.

Now, we also had to work with the export part of MITI. But, again, if somebody says U.S. Foreign and Commercial Service in the blind, they say let us get rid of that. That has nothing in it for me.

Well, I have got a whole bunch of small business people in West Virginia who would slit their throats for the Foreign and Commercial Service right now because they know and saw what it did for them in contracts that allowed them to put West Virginians to work.

So, I just plea, Mr. Chairman, that we deal in this whole debate in facts, in reality, in possibilities, not in ideology.

I thank the Chairman.

Senator BURNS. I am glad to hear that you speak Japanese.

Thank you Mr. Secretary, for coming this morning, and I think this is your first appearance before this committee, and I look forward to the next couple of years working with you in this. And I can assure you that Senator Rockefeller and I will be working on some new competitive legislation that is pointed in the same direction as S. 4, and hope that we can come to a successful conclusion on that because I really believe that it is needed and I think it is the wave of the future. And thank you for coming this morning.

Secretary BROWN. Thank you very much, Mr. Chairman. Thank you, Senator Rockefeller.

Senator BURNS. We now welcome to the committee the next panel. Dr. Mary Lowe Good, who is Under Secretary for Technology Policy for the Department of Commerce; Dr. Jim Baker, Under Secretary for Oceans and Atmosphere; and Dr. Prabhakar, who is Director of the National Institute of Standards and Technology, and that is NIST.

And it has been my great pleasure, when I first came to the U.S. Senate, in going out and visiting the folks at NIST, an organization that I was not even familiar with some 6 years ago, and am familiar with their work.

We welcome you to this committee this morning, and we hope that our working relationship will stay as positive as it can be in this area.

So, I would call on statements now from Dr. Good. Welcome, and good morning to you.

STATEMENT OF MARY LOWE GOOD, UNDER SECRETARY FOR TECHNOLOGY POLICY, DEPARTMENT OF COMMERCE

Dr. GOOD. Thank you very much, Mr. Chairman. First of all, let me say both to you and to Senator Rockefeller, it is really a pleasure to be here and particularly to follow that outstanding testimony which the Secretary set up for us. So, we appreciate the opportunity to be here.

And I would just like to second his thank you for your support of S. 4, and we do hope that it is possible to go forward with something similar to that in this next Congress.

With that, let me just say that I come to this position as Under Secretary with a different kind of background than some of the other folks that you talk to, I spent 20 years in the academic community doing basic research, 13 years in the industry managing commercialization and applied research, and a number of years in appointed positions in the Government trying to help with technology policy.

And as you know, I was on PCAST in the last administration where some of these programs actually got started and got some money put into them for the first time.

The other thing that I would say is that I also grew up, Mr. Chairman, in a rural State that would resemble yours in many ways, which had no manufacturing other than in the forest products arena, and therefore I had to leave the State to use the education which that State had provided. And so I understand your issue very much with respect to how we go about making our programs relevant across the board.

What I want to do very briefly—and I will summarize very quickly. I would like to put my entire statement into the record if I may, and I will try to summarize in about 5 minutes the major issues within it, if that is OK.

What I want to do is provide an overview of the Nation's technology infrastructure and the Government's role in its development. And I would like to say just a few words about the position of the technology administration's program in that overall picture of the Government's activity.

So, let me first just say a few words about the technology administration in the Department of Commerce. It is an agency that includes the National Institutes of Standards and Technology, which has extensive laboratory operations and extramural programs, as you know. It also includes the National Technical Information Service which provides the data banks for the Government's science and technology documents.

Now, through its new electronic media that agency also provides access to the current technology and business information of the Government to a wide audience of customers through an on-line system called FedWorld.

NTIS, however, is unique in that it is essentially a market-driven activity where its expenses are covered by the sale of its products. It does not receive appropriations.

The third component of the technology administration is the Office of Technology Policy, which is a small but dedicated group of professionals who provide the factual analysis on which we rely to make policy decisions for our programs and to assess the technology position of our industries in the country as a whole.

It is also responsible for several Congressional mandated activities in the international technology arena including the United States–Japan program, and several of the U.S. science and technology bilateral agreements.

Thus, my office provides the management oversight for these three agencies, which are designed to support the competitive position of the U.S. technology based industries, both large and small.

I have a small brochure which I will submit as part of the record which gives briefly the themes of these three organizations. And Dr. Prabhakar, who has provided outstanding creative leadership for NIST, will follow me with details of the NIST programs.

So, if I could ask you to focus on the chart which I put up which is at the back of my testimony. If you would like to look at it up close, it provides the detail of Secretary Brown's chart about the connections between the federally funded R&D base and the major investment made in technology by our industrial sector.

Now, first this chart indicates that we are not confused as to the role of the industry and the role of the Government in this technology development area. Clearly, the industrial sector is responsible for the production of competitive products and processes, and for the creation of wealth and new jobs. The Government cannot fulfill these obligations and must let the market drive where these technologies need to be nurtured.

However, the approximately $70 billion of research and development funding that is spent by the Federal Government is for the most part in areas that are widely recognized as the appropriate role for the Government.

For the past 50 years, during the cold war era, we have funded basic research particularly at our universities, and we have provided the resources for our mission agencies to do the necessary applied research and development to meet their mission goals.

These mission related activities are a major share of that $70 billion, and they over time have contributed to our overall health and prosperity.

The early investments in electronics and aerospace for the Department of Defense helped to create a world class computer industry and the aerospace industry.

The dedicated research funding for the National Institutes of Health have been a major source of the creative ideas which have led to the major discoveries and developments in the pharmaceutical and medical industries of our time.

In addition, mission related research has provided many breakthroughs in energy conservation and energy development which would not have been profitable for the private sector.

And last, but not least, the space technologies developed by NASA have made major contributions to the private sector in the form of new materials that are aerospace components and satellite communications systems to name just a few.

Thus, for the last 50 years our science and technology policy has been to support fundamental research in our universities, and at the same time create one of the best cadres of technical talent in the world.

This basic science effort was coupled to our mission related applied research and development, which provided significant spinoff benefits to those sections of the private sector which met the mission goals of the Defense Department, the Department of Energy, and NASA.

At the same time, many of these investments seemed an extraordinarily high risk, and indeed some paid off and others did not, and we all know of some of the successes and some of the failures. But the fact that many of these technology missions were high risk did not deter us from seeking successful technologies to achieve our missions.

During that 50 years, we also had an industry which used a significant portion of its income to build a technology base through the legendary corporate laboratories of companies like General Electric, DuPont, AT&T, Bell Laboratories, and others that all of us could name.

However, in the last few years two significant changes have taken place which make this policy inadequate for the next century.

The first of these changes is the brutal competitiveness of a global economy where products and services can be delivered from many parts of the world. To be able to compete one must provide products and services at a cost competitive price, at a competitive quality, and delivered in a timely fashion.

These global competitive pressures have meant that our industries have had to rethink their investment in a broad technology pool which provided technology for themselves but also spilled over for the good of the country and the world at large.

Thus today, instead of the broad-based central laboratory activities, we find our industries are devoting 90 percent or so of their resources to shorter term product development and process improvement.

This is not an indictment of the industry but a realization that reality today requires this focus on providing competitive products with short lifetimes and generally lower margins.

In addition, the current product life cycle requires the renewal of products or the replacement of products by new ones on a much faster time scale than our old linear research to product development mold would allow.

In the electronics industry, the lifetime of a new model of personal computer today is less than 2 years. Thus, our old way of doing business where we expected the industry to develop much of its own long-term enabling and emerging technologies with a new product cycle of 15 years is obsolescent and unworkable.

Today we must rethink how this system works and what is required to optimize it for the maximum production of high quality jobs and wealth creation in the United States.

I believe that we have no choice but to engage the industry in partnerships with the Government which provide a market pool for technologies out of the Government base, and where we provide the infrastructure and environment necessary for a successful business climate.

I see our technology programs as the bridge that provides that rapid market-driven technology utilization and commercialization.

Now, the range of partnership activities which are given on this chart represent about 5 percent of the total R&D budget of the United States. I believe that is one of the most critical elements of our science and technology policy of today.

And what I would like to leave you with is, I would urge us to understand the system and how it works and what the essential components of it are. It is simply not enough to do fundamental basic research and mission R&D, and hope that our industrial sector will be able to utilize that tech base in both a timely and effective manner.

All of our competitors have looked at ways to bridge this gap, and many of them are spending a significantly higher proportion on this than we are, and you saw the Secretary's charts.

However, it is my view that our approach of using industry led partnerships between the Government and the industry are by far the most efficient and cost effective way to go. In fact, I believe that we will not have the growth in our technology based industries at the turn of the century that will sustain our momentum if these activities are not only engaged in but are also well done.

So, we welcome your inquiry about them, and we welcome your attention to them. And we invite you to review each and every one of them in the detail that is required to decide whether each program contributes to this overall system that I have described.

I believe that it is not a question as to whether these programs should be done. It is a question of whether or not they are contributing to the increasing momentum necessary to make the entire system work for our long-term well being.

I personally believe that our future economic position in the world depends on how wisely and effectively we utilize our technology base, and how we diffuse that technology into our manufacturing and service industries in a way that allows the United States to maintain a reasonable fraction of its wealth creating activities here on American soil.

That means, Mr. Chairman, that making choices between things like the R&D tax credit and our technology partnerships is both a false and dangerous exercise. The R&D tax credit can support the industry's current R&D activities and provide an incentive for doing more, and we should do that.

But these partnerships will provide the technology base for the 21st century. They work together. They are not competitive.

So, as we finish with these, if I can answer any questions I would be more than happy to do so.

[The prepared statement of Dr. Good follows:]

Prepared Statement of Mary L. Good

Chairman Burns, Senator Rockefeller, it is a pleasure to testify before you today on the status and direction of the Technology Administration of the Department of Commerce, and the Clinton Administration's overall technology policy.

Chairman Burns, I particularly want to thank you for your strong support of the Department's technology initiatives over the course of your career. Although we were unsuccessful in getting S. 4, the "National Competitiveness Act," passed last year, your sponsorship of that legislation and hard work in that effort were well recognized—both in industry and in government. I want to personally thank you for your leadership last year, and look forward to working with you and the entire Committee in the years ahead.

I came to my position as Under Secretary for Technology in the Department of Commerce from a somewhat varied background. I spent over 20 years in the Louisiana State University system as a Professor of Chemistry and a Professor of Material Science in the Engineering Research Division. During those years I was fortunate enough to be able to conduct significant research with support from the U.S. Atomic Energy Commission, the National Science Foundation and the National Sea Grant Program. I used those research resources to train several Ph.D. and Masters degree students, as well as a number of undergraduates and postdoctoral fellows. Our research broke new ground in several areas of fundamental inorganic chemistry and in the early development of pre-commercial coating materials and catalysts for chemical processing.

I followed that experience with 13 years in industry as a research manager and finally as a Senior Vice President for Technology for Allied Signal, a company with extensive businesses in aerospace, automotive components, and chemical products. I also spent 11 years as a Presidential Appointee on the National Science Board, with three of those years as the Chairman of the governing body of the National Science Foundation. I also spent two years on the President's Committee of Advisors for Science and Technology during the last Administration.

I provide this background only to indicate that my views on science and technology policy that is relevant for this post-Cold War era is colored by these experiences in basic science, commercial research and development, and science and technology policy. This background and my interest in what I perceive to be one of the greatest issues for the future convinced me to accept this current Presidential appointment to help guide and manage the civilian technology efforts of the government. In terms of investment for our future and as the key to our continued economic security, I believe that our science and technology activities are of the utmost importance.

Thus, I want to provide an overview of the nation's technology infrastructure and the government's role in its development, as well as position the Technology Administration's program in the overall picture of the government's activity.

First, a few words about the Technology Administration in the Department of Commerce. This agency includes the National Institute of Standards and Technology with its extensive laboratory operations and its extramural programs in Manufacturing Extension, Advanced Technology, and Quality programs.

It also includes the National Technical Information Service, which provides the data banks for the government' science and technology documents. Through its new electronic media it also provides access to the current technology and business information of the government to a wide audience of customers through an on-line system called FedWorld™. NTIS is unique in that it is essentially a market driven activity, where its expenses are covered by the sale of its products.

The third component of the Technology Administration is the Office of Technology Policy which is a small but dedicated group of professionals who provide the factual analysis on which we rely to make policy decisions for our programs and to assess the technology position of our industries and the country as a whole. It is also responsible for several congressionally-mandated activities in the international technology arena, including the U.S.-Japan Program and several of the U.S. science and technology bilateral agreements.

Thus, my office provides the management oversight for these three agencies which are designed to support the competitive position of the U.S. technology-based industries both large and small. Our small brochure which I will submit as part of the record indicates very briefly the major themes of these three organizations.

Dr. Prabhakar, the Director of NIST, will follow me with detailed analysis of the NIST programs so I will not go into detail about those programs. I would invite you and your staffs but to NTIS to see how a modern on-line information system works and to assess NTIS' contribution to our competitiveness through its rapid on-line technology information delivery system.

The specific activities of the Office of Technology Policy are very important to our overall function but I will defer in the interest of time in talking about them in detail. [I would like to point out, however, that over the next two months that office will deliver to the Congress a manufacturing assessment document which will explore the diversity of U.S. manufacturing and provide a review of the contributions of the manufacturing sector to the economy as a whole. I can think of no more important information piece that is needed for our continued debate on the technology needs of our manufacturing industries. OTP will also within the next two months provide a Congressionally-mandated report on federal technology partnerships. This document is in response to the Stevenson-Wydler Act to comment and analyze the effectiveness of the technology transfer activities of the Executive Branch. Clearly, this report is important in our decision-making process of which of these activities need to be improved, eliminated, or strengthened. Finally, OTP will provide a departmental document entitled "Technology and Tomorrow" which will provide the vision and strategy which guides our current Civilian Technology Policy. We believe these contributions from OTP will provide value both to us and to you at this critical time in our decisions on what investments the nation must make in our future technology base.] So instead of following up on the details of the activities in these bureaus, I would like to spend the rest of my time putting our technology policy in context. My previous experience will be evident from my comments on my evaluation of where we are today and what we must do to maintain a technological competitive edge which will provide high quality jobs for our children and our grandchildren.

If I could ask you to focus on the chart which I have prepared you can see that it provides the detail of Secretary Brown's chart of the connections between the federally-funded R&D base and the major investment made in technology by our industrial sector.

First, this chart indicates that we are not confused as to the role of, the industry and the role of the government in this technology development area. Clearly the industrial sector is responsible for the production of competitive products and processes and the creation of wealth and new jobs. The government cannot fulfill these obligations and must let the market drive where these technologies need to be nurtured.

However, the approximately $70 billion of research and development funding that is spent by the Federal Government is for the most part in areas that are widely recognized as the appropriate role for the government. For the past 50 years during the Cold War era, we have funded basic research, particularly at our universities, and we have provided the resources for our mission agencies to do the necessary applied research and development to meet their mission goals. These mission-related activities are a major share of the $70 billion and they, over time, have contributed to our overall health and prosperity. The early investments in electronics and aerospace by the Department of Defense helped to create our world-class computer industries and the aerospace industry. The dedicated research funding for the National Institutes of Health has been the major source of the creative ideas which have led to the major discoveries and developments in the pharmaceutical and medical industries of our time. In addition, mission-related research has provided many breakthroughs in energy conservation and energy development which would not have been profitable for the private sector. And last but not least, the space technologies developed by NASA have made major contributions to the private sector in the form of new materials, better aerospace components, and new satellite communication systems, to name just a few.

Thus, for the last 50 years our science and technology policy has been to support fundamental research in our universities and at the same time create one of the best cadres of technical talent in the world. This basic science effort was coupled to our mission-related applied research and development, which provided significant "spin-off" benefits to those sections of the private sector which met the mission goals of the Defense Department, the Department of Energy, and NASA. At the same time, many of these investments seemed extraordinarily high risk and indeed some paid off and others did not. But the fact that many of these technology missions were high risk did not deter us from seeking successful technologies to achieve our missions. During that 50 years, we also had an industry which used a significant portion of its income to build a technology base through the legendary corporate laboratories of companies like General Electric, Dupont, AT&T Bell Laboratories, and others that all of us could name.

However, in the last few years, two significant changes have taken place which make this policy inadequate for the next century. The first of these changes is the brutal competitiveness of a global economy where products and services can be delivered from many parts of the world. To be able to compete one must provide products and services at a cost-competitive price, at a competitive quality, and delivered in a timely fashion. These global competitive pressures have meant that our industries have had to rethink their investment in a broad technology pool which provided technology for themselves but also spilled over for the good of the country and the world at large. Thus today, instead of the broad-based central laboratory activities, we find our industries are devoting 90% or so of their resources to shorter-term product development and process improvement. This is not an indictment of the industry, but a realization that reality today requires this focus on providing competitive products with short lifetimes and generally lower margins.

In addition, the current product life cycle requires the renewal of products or the replacement of products by new ones on a much faster time scale than our old linear research-to-product development mold would allow. In the electronics industry, the lifetime of a new model of personal computer is less than two years.

Thus, our old way of doing business where we expected the industry to develop much of its own long-term enabling and emerging technologies with a new product cycle of 15 years is obsolete and unworkable. Today we must rethink how this system works and what is required to optimize it for the maximum production of high quality jobs and wealth creation in the United States.

I believe that we have no choice but to engage the industry in partnerships with the government which provide a market pull for technologies out of the government base and where we provide the infrastructure and environment necessary for a successful business climate. I see our technology programs as the bridge that provides that raped market-driven technology utilization and commercialization.

So my chart indicates that we have certain activities that are designed to support specifically small businesses and new technology start-ups. The SBIR, or Small Business Innovative Research Program which in 1995 will be slightly over $1 billion should be used to promote high-tech start-up companies and small companies with new high-tech product ideas. In today's world it is difficult for individuals and small companies with creative technical ideas to get venture capital to develop those ideas. Thus, mechanisms like the SBIR Program should be used to bridge that gap so that the ideas can be developed to the point where outside private capital can be raised to continue the development.

In addition, the Manufacturing Extension Partnership is designed to provide access for small and medium-sized manufacturers to appropriate technologies to let them be competitive both in the American market and around the world. Today, even small manufacturers must be globally competitive even if they sell only in the domestic markets, because if they are not competitive, they will be faced with imports which will erode their markets.

Secondly, the two industry-driven cost-sharing programs of ATP and TRP provide a playing field where pre-competitive technologies can be developed in concert with consortia or other appropriate vehicles to do what most single companies would not do, and that is to invest in long-term high-risk technology development before it is clear what the final product and size of the market may be. We also have worked very hard to improve our technology transfer activities where the technology in our federal laboratories can be utilized by the private sector.

We have also developed some strategic partnerships with the industry, Sematech being the earliest example of this class of activities. I believe that Sematech has been a success—with many lessons learned—and that the industry today is quite healthy in part because of both the joint private sector-government funding and the cooperative help the industry members provided for each other in this umbrella organization.

The historic Partnership for a New Generation of Vehicles with the automotive industry is another example. Here we have an industry which provides, either directly or indirectly, about one out of every seven jobs in the United States. It is imperative that this industry stay globally competitive and also meet the social requirements for fuel economy and pollution control. The Partnership's goal of improvement in fuel efficiency of three times the current family sedan is indeed a stretch. But it is an area where the market will not drive the result in a rapid manner under the current prices for petroleum.

The other areas, so-called "virtual partnerships", are those areas where the government can act as a catalyst and as a convener to get industry groups together to discuss roadmaps for their industries and to decide where the technology holes may be. In some of these cases it may be discovered that there are technologies needed which no one company will undertake and there may also be discoveries made of technology opportunities for the private sector.

This range of partnership activities which presently expends about five percent of the total R&D budget, is perhaps one of the most critical elements of our science and technology policy of today. I urge you to-understand this system and how it works and what the essential components of it are. It is simply not enough to do fundamental basic research and mission R&D and hope that our industrial sector will be able to utilize that tech base in a timely and effective manner. All of our competitors have looked at ways to bridge this gap and many of them are spending a significantly higher proportion on this than we are. However, it is my view that our approach of using industry-led partnerships between the government and the industry are by far the most efficient and cost-effective way to go. In fact, I believe that we will not have the growth in our technology-based industries at the turn of the century that will sustain our momentum if these activities are not only engaged in but well done.

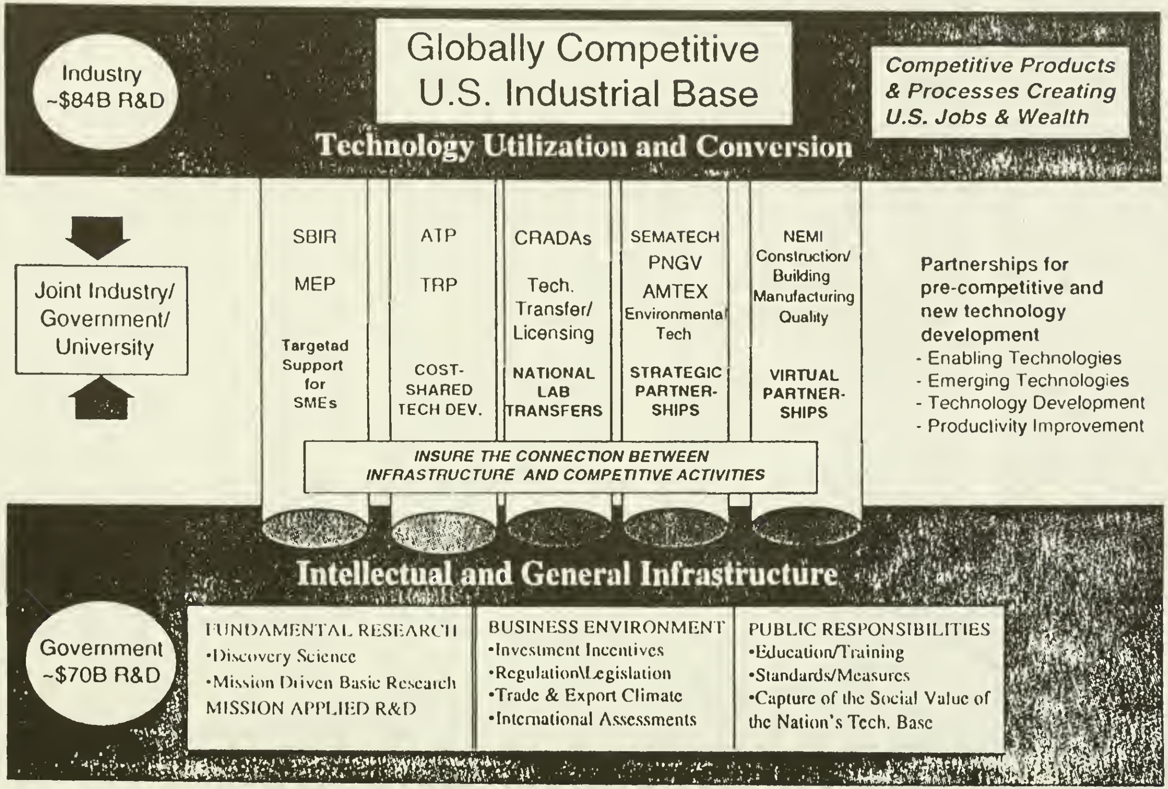
We welcome your inquiry about them,, and we welcome your attention to them, and we invite you to review each and every one of the them in the detail that is required to decide whether each program contributes to this overall system I have described. I believe that it is not a question as to whether these programs should be done, it is a question of whether or not they are contributing to the increased momentum necessary to make the entire system work for our long-term well-being.

I personally believe that our future economic position in the world depends on how wisely and effectively we utilize our technology base and how we diffuse that technology into our manufacturing and service industries in a way that allows the United States to maintain a reasonable fraction of its wealth-creating activities here on American soil.

That means, Mr. Chairman, that making choices between things like the R&D tax credit and our technology partnerships is a false and dangerous exercise. The R&D tax credit can support the industry's current R&D activities and provide an incentive for doing more. Our partnerships will provide the technology base for the 21st century. They work together; they do not compete.

If I can answer any questions, I would be more than happy to do so. I very much appreciate the opportunity to discuss these issues with you .

Enabling the Nation's Capacity to Perform in a Global Community



Industry
~$84B R&D

Globally Competitive
U.S. Industrial Base

Competitive Products
& Processes Creating
U.S. Jobs & Wealth

Technology Utilization and Conversion

Joint Industry/
Government/
University

SBIR
MEP
Targetad Support for SMEs

ATP
TRP
COST-SHARED TECH DEV.

CRADAs
Tech. Transfer/ Licensing
NATIONAL LAB TRANSFERS

SEMATECH
PNGV
AMTEX
Environmental Tech
STRATEGIC PARTNER-SHIPS

NEMI
Construction/ Building
Manufacturing
Quality
VIRTUAL PARTNER-SHIPS

Partnerships for pre-competitive and new technology development
- Enabling Technologies
- Emerging Technologies
- Technology Development
- Productivity Improvement

INSURE THE CONNECTION BETWEEN INFRASTRUCTURE AND COMPETITIVE ACTIVITIES

Intellectual and General Infrastructure

Government
~$70B R&D

FUNDAMENTAL RESEARCH
•Discovery Science
•Mission Driven Basic Research
MISSION APPLIED R&D

BUSINESS ENVIRONMENT
•Investment Incentives
•Regulation\Legislation
•Trade & Export Climate
•International Assessments

PUBLIC RESPONSIBILITIES
•Education/Training
•Standards/Measures
•Capture of the Social Value of the Nation's Tech. Base

Senator BURNS. Thank you, Dr. Good. In keeping with that line, Dr. Prabhakar, we will go with your testimony.

Dr. PRABHAKAR. Thank you, Mr. Chairman. It is a pleasure to be here with both of you today. I am really pleased that you are taking a very early start and getting the record built to discuss what these programs are all about.

Mr. Chairman, you specifically mentioned the growth that has happened in the programs at NIST as one of the reasons it is appropriate to be looking at the activities we are engaged in today. And you are absolutely right, the growth has been rapid in the last several years. We have been quite focused on how we build that capability to deliver value rather than building bureaucracy. I would be happy to discuss that in greater detail.

But I want to stress, as Secretary Brown and Under Secretary Good have done, that while we are a very small part of overall Federal R&D—this is the first year we have been more than 1 percent of the Nation's Federal R&D investment—we are a critical part of these linkage programs. I like to think of them as the pillar program to help hold up the roof of this building, and link to the foundation that the $70 billion in Federal R&D is providing. And so if you look in that portion, I think you will find that our role is really quite significant, and that is really what I want to try to focus on today.

NIST programs, as you know, are actually a portfolio of four different programs. They are different mechanisms to address different industry needs. To begin with, our core capabilities and our NIST laboratories, the old National Bureau of Standards, our predecessor organization, if you like, is that part of our portfolio that dates back nearly a century today. The job, there, is to serve as the Nation's measurement laboratory, to provide the infrastructural technologies of measurements and standards and evaluated data and test methods and protocols, so that industry has a common language for its technical enterprise. I think that is a job that we have done very well and we are strengthening today.

In addition to that traditional core, in 1988 when Congress, driven by this committee, changed our name, they also gave us some new ways of doing business with the industry. One of those is the Advanced Technology Program (ATP) that we have been discussing already this morning. The way ATP works, of course, is to fund projects in companies on a cost-shared basis, and here the objective is to help tackle the jobs that are longer-term and riskier, the things that companies cannot do by themselves but which can create tremendous opportunities for our economy downstream.

The third program in our portfolio was also begun in the late eighties, and that is our Manufacturing Extension Partnership (MEP). That includes the State Technology Extension Program that, Senator Rockefeller, you and Mr. Bohlert in the House helped trigger. The MEP is designed to work to provide access for information and expertise for our smaller manufacturers, the 370,000 smaller manufacturers that are spread across our country. In that program we work in direct partnership with State and local governments to build that capability. Our focus, again, is the smaller manufacturers that need to become more competitive and more aggressive and that we are able to help by giving them the tools so that they can implement new technologies on their factory floors.

The fourth program in our portfolio is the Malcolm Baldrige National Quality Award, which of course recognizes the best examples of quality practices every year, but I think much more importantly also generates a set of criteria that thousands and thousands of companies and other organizations use to improve their quality processes.

Underpinning all of these programs, underpinning every effort that we have at NIST, are a set of principles. And I really want to stress that it is these principles that we return to, it is these principles that drive everything that we do, and I think therefore that it is worth discussing a little bit what those drivers are.

First and foremost, we believe that the appropriate role for the Federal dollar in R&D is to tackle the longer-term, the riskier, the infrastructural technologies. We have a long tradition in this regard. Our mechanisms are new, and I think therefore are much more effective in the current global competition that our companies face. But again, we do not think that the Government's role is to replace the private sector investment that is, in fact, a quite substantial investment in R&D. We treasure the fact that our private economy is so strong, the fact that our companies are able to take technologies and turn them into products and services, turn them into the profits and jobs that really drive our economy. I think our programs are explicitly designed to maximize the value in our market economy.

Second, a key issue for us is that priorities for all of our programs are driven by industry. For example, if you look in ATP you will find that every project, every program we undertake in ATP, begins with an idea from companies, from industries, and again, that has been discussed this morning.

Third, in each activity at NIST, the funding decisions for where the dollars are allocated are driven by a rigorous, competitive, merit-based process. We think that is the best way to ensure that we are getting the greatest impact for the dollars that we are investing, and we find in that process, again, for example, if you look in ATP, that small companies are able to compete and win because we in fact have a process that is very open for them. So you will see a very substantial participation, I think quite appropriately, since they are the places where so much of the innovation and entrepreneurship lies in our economy.

And finally, the fourth principle in our activities is to focus on evaluation. We believe in measuring the results of these activities so that we can control and improve our processes, but also most fundamentally because we want to make sure we are delivering bottom-line value for the economy and for our taxpayers.

My full statement, which I would like to submit for the record, has substantial details on what each of our programs are doing and what the early results are in our new programs. Let me just indicate in terms of what we are providing in terms of delivering results for our taxpayers and our economy, first of all that our laboratories have, again, nearly a century's history of providing value for our industries. I think we have been able to strengthen that, but I think we have a long track record and a demonstrated ability to provide the infrastructural technologies that have tremendous leverage in enabling our industries.

In our new programs, particularly the Advanced Technology Program the Manufacturing Extension Partnership, it is too early today to see full-blown economic results from those kinds of long-term investment that began just a few years ago. But what we do know today is that we are seeing the early signs of progress today that will lead to full-blown economic results tomorrow, and again, we have got the processes, I think, firmly in place to make sure that that happens.

Mr. Chairman, Senator Rockefeller, I am serving in this position today because I believe that the programs at NIST can have the greatest economic bang-per-buck of any part of the Federal R&D investment. It is not rocket science; it is for a couple of basic reasons. We are building on a solid foundation. It is a foundation that this committee helped to begin and helped to form. Beyond that, our programs are designed and implemented and evaluated with industry, with a constant focus on economic results. That is why we come to work every morning, and that is how we measure our value-added for the taxpayer when we go home at the end of the day.

So I am very pleased to be here to talk about our programs. I would be happy to discuss them in greater detail. Thank you.

[The prepared statement of Dr. Prabhakar follows:]

PREPARED STATEMENT OF ARATI PRABHAKAR

Mr. Chairman and Members of the Subcommittee, I welcome the opportunity to discuss with you the work of the National Institute of Standards and Technology, and to explain how our efforts are helping to strengthen the U.S. economy.

I especially want to applaud you, Mr. Chairman, for scheduling an early hearing that allows the Subcommittee to gather more facts about our programs to help you make critical decisions that will affect the future of U.S. industry.

NIST's mission is straightforward and unique. As part of the Commerce Department's Technology Administration, NIST promotes U.S. economic growth by working with industry to develop and apply technology, measurements and standards—providing the basic technical infrastructure needed by U.S. industry. We concentrate on industry because it is industry that transforms technology into the products and services, the profits and jobs that yield the true returns to American taxpayers.

I want to put NIST's efforts into perspective by setting out four fundamental principles that drive all of our work:

- NIST focuses on critical jobs vital to the country's technology infrastructure that neither industry nor the government can do separately. These are technology jobs that private companies cannot or will not take on by themselves—because they cannot capture the broad-based benefits that will accrue to the economy at large, or because the time-frame is too long and the risk too great. Before we take on a task, we must be assured that our efforts do not replace or substitute for any efforts by the private sector.
- Industry drives all of our priorities and plays a critical role in helping us to carry out our work. Industry's priorities, not government's, guide NIST's work.
- Rigorous, open, technically sound and competitive processes are the hallmark of all of our efforts. All of NIST's programs are strictly merit-based and have long been executed free from political influence.
- We rely heavily on evaluation of our work to ensure that industry and the taxpayers are receiving the greatest possible return on their investment.

Mr. Chairman, I will unabashedly assert that NIST can deliver the greatest economic bang for the buck out of the entire $70 billion the federal government invests in research and development. Our laboratories already have a 90-plus year history of working closely with small and large companies, coupled with a reputation for neutrality and technical excellence. That is why NIST was selected by Congress in 1988 to tackle these added assignments—the Advanced Technology Program and the Manufacturing Extension Partnership.

Unlike any other R&D-oriented federal agency, everything we do is designed to partner with industry to strengthen our economy. Our successes in assisting U.S. companies are not accidental—and they are not spinoffs. They are the very reason why we exist.

It is still too early to claim broad-based impacts on our economy for these newer programs—they have only recently moved out of the start-up phase. But we already have indicators that point to the kinds of successes that Congress, industry and all taxpayers should demand from government agencies.

I will back up those statements with some details about our efforts. But there is one other point I want to highlight.

NIST's appropriation of $855 million in fiscal year 1995 is the only portion of the federal budget devoted explicitly to enhancing and leveraging industry's development and use of technology—and it amounts to just over one percent of federal R&D and less than one-half of one percent of the nation's total R&D expenditures. As we talk about the value of our efforts and NIST's impact in helping industry, we need to keep this sense of proportion in mind.

NIST has a portfolio of four major programs designed to meet needs identified by industry. I would like to briefly describe each program, explaining our principles, our progress, and some of the results that we have delivered recently to industry.

ADVANCED TECHNOLOGY PROGRAM (ATP)

The Advanced Technology Program is a rigorously competitive program which invests in cost-shared research by individual companies or industry-led joint ventures. The sole aim is to develop high-risk, potentially high-payoff enabling technologies that otherwise would not be pursued at all or in the same market-critical time frame because of technical risks and other obstacles that discourage private-sector investment. These other obstacles include long pay-back horizons, or anticipated returns that are distributed so that individual firms or specific industrial sectors are reluctant to invest.

ATP is industry-oriented. While government provides the catalyst—and in many cases, critical technical support—industry conceives, manages, and executes each ATP project. Industry proposals are based on the private sector's understanding of market trends and future opportunities. All projects are selected on the basis of both technical and business merit through a fair and rigorous competition that draws on both government and private sector expert reviewers.

Mr. Chairman, it remains fashionable to talk about "picking winners and losers." That phrase truly yields more heat than light. In one sense, "picking winners and losers" is the old way of setting federal R&D priorities. The federal government long ago picked agriculture, aeronautics, space, energy and health. The whole point of the ATP is to maximize economic impact by letting industry's ideas—backed up by their financial commitment—determine what is funded. That is the new concept in federal R&D that is embodied in the ATP.

Suggesting that programs like the ATP pick winners and losers also underrates the tremendous efforts of our industries. Consider what it really takes for a company to make a winner in the market: product development, manufacturing and production, global marketing and sales, distribution and service systems. All of these jobs belong to industry, and ATP is doing none of them. ATP's job is to cost-share the high-risk, enabling R&D that is upstream of product development, creating new opportunities for companies to pursue.

The acid test is simple: ask any ATP participant what it will take to launch a successful product in the marketplace beyond the work being performed with government-provided funding. Their own investment will always be substantially larger than the government's relatively small cost-shared funding. And that added investment comes not from the ATP, but from the private sector.

I want to emphasize one other feature about ATP that has been too often misrepresented. The ATP works for companies of all sizes—the tiny startup, the medium size company, and the large corporation—as well as combinations of companies. To date, about half of the ATP awards have gone to small companies or joint ventures led by a small company. That represents a much greater small business involvement than typical federal R&D programs.

ATP Progress to Date

Overall, NIST has conducted 10 competitions and funded 177 projects to provide a little less than half the funding for over a billion dollars of high-risk research. NIST has conducted five general ATP competitions open to proposals from all areas of technology. Through these general competitions, we have made 121 awards, committing a total of $332 million in ATP funds with $370 million in cost-sharing funds from industry.

Through a series of public meetings with industry, we found widespread support for the idea that focused programs can help maximize the ATP's leverage by driving key strategic technology areas. Industry demonstrated that support by submitting nearly 900 ideas for focused ATP program areas since October 1993.

We have had several thousand industry representatives taking part in our ATP workshops. Those sessions have tremendous value, not just in helping to plan our program, but in convening different segments of industry to discuss mutual goals and interests.

NIST has conducted five focused program ATP competitions, all in 1994. We made 56 awards, committing a total of $224 million in ATP funds with $229 million in cost-sharing funds from industry. Last month, based on industry suggestions, we launched an additional six focused programs. We are just beginning those competitions now, and industry's involvement and interest is very strong.

With a total of 11 focused programs underway, the broad industry participation is evident in the range of topics: Manufacturing Composite Structures; Information Infrastructure for Healthcare; Component-Based Software; DNA Diagnostics; Computer-Integrated Manufacturing for Electronics; Materials Processing for Heavy Manufacturing; Vapor Compression Refrigeration Technology; Catalysis and Biocatalysis Technologies; Digital Video in Information Networks; Digital Data Storage; and Motor Vehicle Manufacturing Technology. These programs are each $50–185 million efforts spread over four-to-five years. Companies from every sector continue to plan new programs.

To date, more than 400 organizations, including companies, universities, independent non-profit research organizations and government laboratories have participated directly in 177 ATP projects. The attached graphic gives you an idea of the growing number of companies, large and small, that have been able to participate in this program. In addition, several hundred additional organizations participate informally as subcontractors and strategic allies. Our ATP managers have carried out a vigorous outreach program to make firms and economic development organizations in states and localities across the country more aware of the ATP, its potential, and its procedures.

ATP Impact

ATP has placed a high premium on evaluation of its programs from the very start. Our process has five elements:

- assessing ATP's own critical operational activities;
- "portfolio" profiles of applicants, recipients, technologies, and projects;
- evaluation of industry's implementation of both the R&D and business components of ATP projects;
- tracking short-term and intermediate project results; and
- measurement of long-term economic impacts.

What we really care about is that last category: long-term economic impacts. The primary goal of the ATP, and the real payoff, is the economic growth in the future that will come from the introduction of new products and industrial processes based on ATP-supported R&D. Ultimate ATP results occur significantly later than the ATP projects that cause them.

But because the ATP invests only in pre-product technology development, because it is still a very modest program in terms of the larger R&D enterprise, and because nearly all of the projects it funds are still in the research phase, no one should expect to see major impacts on the economy this soon.

Having said that, we can track some early indicators that the projects are on course and the economic potential is building.

- *Encouraging high-risk R&D.* The ATP has been successful in attracting relatively high-risk R&D projects that otherwise would not be attempted.
- *Promoting research efficiencies and reduced time-to-market.* The joint ventures and alliances fostered by the ATP are reporting significant research efficiencies and early use of research results.
- *Progress on commercialization.* The results of ATP R&D projects are being incorporated into commercial products by companies. Information from 40 small companies revealed this progress:

  30 percent reported incorporating improvements resulting from the ATP project into existing commercial products.

  18 percent were implementing an improved production process resulting from the ATP project.

  38 percent were producing and shipping to potential customers commercial prototypes of products based on the ATP-funded technology.

  20 percent were producing and selling to customers products derived from the ATP-funded technology.

- *Business growth.* An important measure of the economic impact of the ATP is the growth of companies—particularly the growth of jobs—as a result of ATP technologies. Immediate job growth as new research staff are brought in to work on a project is not the point; rather, we focus on projections of job growth as a result of the use of ATP-sponsored technologies. Recent data from 32 small firms working on ATP projects showed that over 90 percent expected to add new employees within five years as a result of ATP technologies. Nearly half of the companies expected to add substantial numbers of employees.

Those are some of the quantifiable early results from ATP cost-shared projects with industry, and they tell us we are on track. But remembering that it is the longer-term impacts that we are aiming for, there are two far more important indicators.

First, ATP is enabling U.S. companies to see entirely new market opportunities opening up with the development of revolutionary new technologies that break all of the traditional molds.

Second, these companies often are discovering that they can best take advantage of these new markets by teaming with other firms. The ATP has stimulated the formation of strategic R&D alliances both horizontally, among competitors, and vertically, between customer and suppliers.

Two examples provide insights about how ATP is meeting its goals and serving industry.

The Genosensor Consortium

One goal of the Advanced Technology Program is to help industry change the rules, to provide a springboard for revolutionary technological advances harboring big economic potential. An ATP project now under way by the Genosensor Consortium fits this ideal like a hand in a glove.

One of the consortium's major technology goals is to develop DNA analysis technologies that will take off where the Human Genome Project (HGP) stops. The HGP is a federally funded, multibillion dollar effort to map and ultimately sequence all human genes. An early payoff is expected to come in the form of more reliable and inexpensive diagnostic tools that can help reduce health care costs and human suffering through earlier intervention or lifestyle changes. In the longer term, the basic genetic knowledge developed in the HGP could help change the paradigm of medical practice. Rather than being relegated to responding to health problems that already have emerged, doctors could begin to shift their focus to managing—even preempting—potential health problems revealed through DNA analysis.

The Genosensor Consortium's six companies, two academic institutions, and independent research organization hope to realize that vision by developing plug-and-play, tabletop instruments capable of inexpensive and rapid analyses of DNA samples. This is the kind of tool that can convert the vast storehouse of data coming from the HGP into useful information valuable to doctors and patients, biotechnologists, public health officials, and many others. In addition, these same tools could open doors to more effective microbial screening of water supplies and food, to more affordable large-scale toxicological screening, and to more effective genetic engineering of plants and animals, and to chemical manufacturing applications.

That such a technology is needed is clear. With today's analytical methods, it takes days or weeks, skilled technicians, and at least $100 for even the simplest DNA analysis. By synergistically combining the fields of microelectronics and molecular biology, the consortium aims to unlock the widespread potential of DNA analysis and develop an easy-to-use machine that can do analyses in less than an hour at a cost at or below $10.

It is no surprise that the R&D challenge here is formidable, expensive, and risky. It requires the equivalent of miniaturizing a room-sized analytical laboratory onto a chip. With the ATP serving as the catalyst, the consortium formed because no one company had all of the in-house expertise in chemistry, biology, software design, microfabrication techniques, system engineering, and other technical areas to even prove the concept of a tabletop DNA analyzer. The ATP is providing a framework in which the financial and technical risks for each consortium member come down to acceptable levels. Consequently, by encouraging companies to share the risks, the ATP promotes the aggressive development of revolutionary technology that has historically paved the road to broad U.S. economic prosperity.

Auto Body Consortium

Assembling car bodies has a lot in common with assembling jigsaw puzzles. In both cases, each of many pieces must fit nearly flawlessly with its neighbors. Even minuscule misfits and misalignments can accumulate into unappealing results. The challenge for U.S. auto makers is to achieve manufacturing uniformity that improves quality, reduces costs and shortens time to market. Uniformity also is the key to tighter fitting doors, less wind noise, and fewer rattles and vibrations, all of which play pivotal roles in the perceptions and decisions of car buyers.

That is why in 1992 eight small technology suppliers joined to form the Auto Body Consortium (ABC) and teamed with General Motors, Chrysler, and researchers at the University of Michigan and Wayne State University. The ABC credits the ATP as the catalyst for this trailblazing collaboration. The government provided $4.8 million to the consortium of small companies. GM and Chrysler together pitched in $2.25 million of the nearly $6.5 million of matching funds required in the ATP agreement. In only three years, the effort has yielded versatile new software, mathematical techniques, manufacturing technologies, and ways of transferring information among researchers, suppliers and automakers. Together, these innovations can reduce the total variation of U.S.-made car bodies from the typical 3–5 millimeters to 2 mm or less—roughly the thickness of a nickel. Toyota already had reached that level of uniformity to become the industry benchmark. European and other Pacific Rim rivals have been closing in. Now, because of the unprecedented common ground that the ATP provided—even for arch rivals—U.S. industry has caught up to the leaders. What's more it has done so in a way that promises a long-term competitive advantage. Similar to Toyota's approach, the ABC techniques and technologies maximize worker contribution, yet the ABC approach also harnesses America's unique advantage in innovative manufacturing technologies. The goal has been demonstrated in the manufacture of several vehicle models at the Chrysler Jefferson North (Michigan) assembly plant, the GM Shreveport (Louisiana) plant and the GM Linden (New Jersey) plant, where it took only 15 weeks to reduce variation levels to a world class 2.00 mm. Now that level is down to 1.74 mm. As discoveries have been made during this ATP project, which officially ends in September, industry has invested quickly to rapidly implement the newly validated manufacturing technologies into their assembly lines. With this proof that collaborative R&D can work, many in the auto industry seek to replicate the ABC model in other major manufacturing steps including metal stamping, welding and joining.

MANUFACTURING EXTENSION PARTNERSHIP (MEP)

The Manufacturing Extension Partnership is a true grassroots effort to improve the competitiveness of smaller manufacturers: companies with fewer than 500 employees that number more than 370,000 and account for about 95 percent of all U.S. manufacturing plants. The MEP helps these smaller manufacturers succeed in the marketplace by allowing them to improve their operations through the use of appropriate technologies. The computer revolution has yet to arrive at a surprising number of these firms; many still are using manufacturing technologies from the 1950s and 1960s. Meanwhile, competition overseas is getting tougher by the day.

These smaller companies are assisted by manufacturing engineers from MEP's growing nationwide network of affiliated manufacturing extension centers run by local, state and non-profit groups. The MEP takes maximum advantage of programs already in place, avoiding duplication of efforts among existing technology assistance organizations. It concentrates on matching company needs to available help regardless of source.

The MEP provides federal funds to both existing and new extension centers so that they can meet the needs of area manufacturers. All centers are chosen in rigorous, merit-based competitions, and all federal funding must be matched by the state. The MEP includes the State Technology Extension Program, offering support to states and communities so that they can begin building the foundation of organization relationships required for the efficient delivery of services, which might include a Manufacturing Extension Center. We are placing a very high priority on working with those areas of the country which do not yet have this foundation in place.

Having a nationwide system managed through NIST offers the centers a system-wide array of supporting services and information resources—and discourages duplication of effort. As conduits to MEP client companies, the centers can increase the depth and breadth of expertise readily available to local firms.

As the client companies become more competitive, their prospects for long-term growth improve. So do opportunities for retaining existing jobs, creating new high-skill, high-wage jobs and reaping economic benefits related to maintaining America's value-added manufacturing industry, and additional service industry jobs needed to support that manufacturing base.

MEP Progress to Date

In 1993, fewer than one smaller manufacturer in 20 was located within the service areas of the seven federally sponsored extension centers. Since then, dramatic progress has been made.

Now, 44 MEP centers are operating or are preparing to open their doors in 32 states. Those non-profit centers employ professional engineers and others with manufacturing or business experience who are opening the doors to information and expertise for small manufacturers.

MEP partners with state and local governments to establish nonprofit manufacturing extension centers in the nationwide MEP. These centers leverage state, local, and regional programs along with a widening national array of assistance efforts.

This expansion has been enabled by the Technology Reinvestment Project (TRP), led by the Defense Department's Advanced Research Projects Agency. The TRP has provided funds—matched by state and local sponsors—that enable the MEP to extend its geographic reach. Thirty-seven of the NIST-managed affiliated centers were funded by the TRP. TRP also has provided matching funds for training modules, assessment tools, and other services that will help the individual MEP centers to deliver quality services to client firms. The MEP is now well positioned to carry on the work that has been jump started by TRP funds.

Earlier this month we announced a jointly funded initiative with the Environmental Protection Agency (EPA) to help smaller manufacturers become both more competitive and more environmentally conscious. The initiative will support the development of methods and approaches to integrate environmentally focused services into the portfolio of manufacturing extension center services. It also will support the development of new tools to help manufacturing extension organizations deliver these services to smaller manufacturers. In addition, we will support the establishment of industry-specific pilot centers.

MEP Impact

Our centers have been busy. They served nearly 9,000 manufacturers during the first three quarters of 1994, helping smaller manufacturers through hands-on assessments and advice, technology demonstrations, training, and seminars on specific manufacturing and business-related issues.

Surveys of our client firms are showing that manufacturing extension services are fostering significant improvements in manufacturing and business performance, yielding company-estimated benefits that greatly exceed the federal investment in the MEP. For example, during that same nine-month period, 395 companies returning surveys to the original seven centers reported an economic impact of more than $82 million for technical assistance projects provided by MEP. Those impacts include changes in sales, capital spending and capital avoidance, inventory reductions, labor and material savings, and jobs created or saved. These results are consistent with our earlier evaluations.

The MEP is also sparking changes in the behavior of private and public-sector providers of extension services and advice. Federal support and access to a national network of supporting services is enabling previously existing, state-sponsored centers to extend their reach, develop new capability, and broaden the range of service available to companies. Moreover, private sector consultants are finding that, by working with the Centers, they have better access to smaller manufacturers as clients. A 1994 study found that MEP client firms are more aware of the competitive benefits of using modern technologies than non-client firms. They also are more likely to be planning to implement those technologies. More than 90 percent of the consultants surveyed said that MEP-assisted companies are more knowledgeable of outside consultants than firms that do not use extension services.

NIST LABORATORY PROGRAMS

NIST's laboratory programs have long been recognized for their practical assistance to industry and their focus on infrastructural technologies that support our economy. Our laboratory efforts are planned and implemented in cooperation with industry and focused on infrastructural technologies such as measurements, evaluated data, standards and test methods which provide a common language for use by industry in commerce.

Industry traditionally underinvests in the development of these infrastructural technologies because they are used simultaneously by many firms. These infrastructural technologies typically are not embodied in products, making it difficult or impossible for individual firms or even industries to recover the R&D investment it would take in order to develop these technologies. The benefits from this work are spread across many companies and industries, and the economic impact can be great.

The NIST laboratories operate with a customer base as diverse as U.S. industry itself. They include makers of one-of-a-kind scientific instruments, utilities that supply gas and electricity to tens of millions of commercial and residential customers, software publishers and computer manufacturers, aerospace giants, aspiring biotechnology firms, chemical and food processors, textile manufacturers, makers and users of machine tools, suppliers of steel and concrete, and designers of exotic new materials. Customers range from tiny start-ups to the "Big 3" auto makers and most other companies among the nation's top 100 R&D spending firms.

NIST Laboratories' Progress to Date

Appropriations for NIST laboratories have increased by 37 percent between fiscal years 1993 and 1995—the first discernible increases for these critical efforts in decades. These increases have permitted NIST to strengthen our core capability for infrastructural technologies. We have accomplished this without increasing our staff; those who were working to support other agencies' needs have shifted to NIST funding so that they may respond even more directly to industry needs. Also, planning is underway for the renovations and new construction that is vital if the labs are to meet industry's needs in the coming century. I am particularly proud of three accomplishments:

- We have been able to more aggressively tackle industry's infrastructural technology needs in emerging areas of technology that have grown in the past decade. For example, two areas where we are bringing greater resources to bear in biotechnology and information technologies. Both are clearly huge growth areas for industry, and neither can move ahead easily without the kinds of underlying research and services done by the NIST laboratories.
- The underlying base for metrology, the science of measurements, has been revitalized. For example, our scientists recently trained an array of four lasers on cesium atoms, trapping and cooling them to within 700 billionths of a degree of absolute zero, the coldest temperature ever reported for an atom measured in three dimensions. This accomplishment eventually may lead to improvements in the accuracy of atomic clocks; each past improvement has led to almost immediate technological applications, from synchronizing telecommunications and electrical power grids to the Global Positioning System.
- We have broken through years of uneasy relations with our partners in the private sector voluntary standards community, forging new, stronger relationships and bolstering our own standards-related activities. This improved cooperation is critical in light of new international trade agreements and activities. Industry now can count on NIST to deliver more promptly vital standards-related information and services, and to be a better partner in representing U.S. interests in the international arena.

Our laboratories' formal linkages with industry remain as strong as ever. During the past year, NIST entered into 133 new Cooperative R&D Agreements, or CRADAs. Of NIST's 500-plus CRADA partners since 1988, 40 percent have been small businesses, 45 percent have been large or mid-sized firms, and 15 percent have been universities and other organizations. On average, one technical staff member in five is engaged in a CRADA—just one indicator of industrial interactions.

NIST Laboratories' Impacts

Several hundred laboratory projects are under way at NIST during a single year. Some relate to the needs of mature industries. Others concentrate on technical challenges confronting emerging industries, and on established high-technology sectors undergoing rapid technological change: All are conducted with industry helping to set the priorities and guiding the work. Most are carried out with industry's active involvement.

Below are several typical projects that give a flavor of how recent NIST laboratory efforts have worked for U.S. industry.

- Faced with the imminent elimination of ozone-destroying chlorofluorocarbons (CFCs) and the phaseout of related refrigerants, the nation's $17 billion air conditioning and refrigeration industry now is using a NIST-developed database which calculates key thermophysical properties of 38 refrigerants and mixtures. In the search for cooling systems that are both environmentally and economically acceptable, industry needed high-quality data. An official of the Air-Conditioning and Refrigeration Institute, an industry association, says, "Without NIST, we would have gotten less detailed data, which would have meant a lot more expensive, time-consuming engineering work to produce hardware. It would have cost us millions more."

- A NIST tool for quickly evaluating the performance of coordinate measuring machines—used by many manufacturers to check the dimensions of parts and assemblies—is helping U.S. firms improve their quality assurance methods and cut costs. Manufacturers now can comprehensively assess CMM performance quickly, decreasing the chances that companies will ship poor-quality parts to their customers or scrap good parts mistakenly. Evaluated by Caterpillar Inc. and Boeing, the NIST tool has been commercialized by Giddings and Lewis, a U.S. maker of these measuring machines and machine tools. The product was introduced last year, and already has markets in the aerospace, automotive and heavy equipment industries.
- NIST recently issued a standard optical fiber that is helping U.S. fiber makers to reduce product variability and greatly improve the likelihood that spliced fibers will align precisely—ensuring the high quality transmission of signals that their customers expect. An official with Corning, Inc. reports that this capability has given "Corning and other fiber manufacturers a clear competitive edge."

NIST aims for and expects its infrastructural technologies and services to yield high returns since we expend resources only once to develop, for example, a measurement method that can be used by many companies and frequently for entirely different technologies. Results of an ongoing series of economic impact studies confirm those returns. To date, 8 economic impact studies have been completed, yielding a median rate of return of 167 percent. These returns compare very favorably with those reported in studies of returns on other public investments in technology and on private sector R&D investments.

For example, a recent study shows that through improved calibration services NIST has enabled a tenfold increase in measurement accuracy of watthour meters. In turn, that has allowed U.S. electric utilities to more accurately monitor more than $180 billion of electrical power generated annually, facilitating the resolution of disputes and generating a sizable return to U.S. taxpayers. A new analysis estimates that total benefits exceed costs by a ratio of 41 to 1.

NIST QUALITY OUTREACH PROGRAM

With the cooperation and financial support of the private sector, NIST manages the Malcolm Baldrige National Quality Award, which has become both the U.S. standard of quality achievement in industry and a comprehensive guide to quality improvement.

The award program was established by Congress in 1987 not only to recognize individual U.S. companies for their quality achievements, but also to promote quality awareness and to provide information on successful quality strategies. The major focus of the award is on results and customer satisfaction; it is not given for specific products or services.

NIST has worked closely with a variety of groups to extend the benefits of quality management and stimulate activities nationwide. These organizations range from trade, professional and business groups such as the National Association of Manufacturers, the Council on Competitiveness, and the U.S. Chamber of Commerce, to state and local government organizations and broad-based interest groups like the National Education Association.

Key to this program—and indicative of its cooperative nature—is the award's board of examiners. Made up of more than 250 quality experts from many industry sectors, along with a smaller contingent from universities and governments at all levels, board members volunteer many hours reviewing applications for the award. They have given more than 10,000 presentations on quality management and the award program, helping to spread the message and tools and techniques for improving quality management.

Quality Award Progress to Date

From 1988 to 1994, the award program received nearly 550 applications form U.S. companies. Twenty-two companies, including 11 large manufacturers, five service companies, and six small business have won the award. But the program is much more than a contest. Equally important is the award's role in raising awareness by encouraging all U.S. business and organizations to implement quality improvement efforts whether they intend, or are even eligible, to apply for the award.

About 1 million copies of the award's guidelines and criteria have been distributed by NIST worldwide, and thousands of organizations are using the criteria as a quality improvement road map. The results of these internal evaluations provide firms with a clear view of where they stand and of how far they must go to achieve world-class levels of quality.

Forty-two state and local quality award programs are operating in 30 states—most modeled after the Baldrige Award. Many companies participate in these award programs before applying for the national award.

With experts from health care and education, NIST has adapted the Baldrige criteria and framework for these sectors and is launching a pilot program. Pending a successful 1995 trial, continuing support from these two sectors, and funding, full-scale award programs for education and health care could begin in 1996.

Quality Award Impacts

The Baldrige Award program is having a profound effect on how people and organizations operate and work. An independent 1993 study to determine what U.S. business thinks about the award indicated that both industrial and service firms—large and small—agreed that the award currently provides the best framework for a total quality management system. The results also showed that the firms surveyed believe the award fosters quality awareness, promotes the understanding of the requirements for quality excellence, promotes sharing of information on successful quality strategies, and recognizes U.S. companies that excel in quality achievement and quality management.

Preliminary results from a more recent survey of U.S. firms conducted last fall by the award's independent advisory group indicated similarly strong support. Seventy-one percent of those 52 companies responding said they used the award criteria as a quality management assessment tool, and 86 percent said that sharing of practices by Baldrige Award winners has helped to motivate improvements in their own businesses.

Good quality management is no guarantee of business success, but it can lead to outstanding returns—both for individual companies and for the country. These returns are showing up in increased productivity, satisfied employees and customers, and improved profitability. Recent studies by NIST and others have found that a stock investment in the group of companies winning the award could result in large returns. For example, a hypothetical $1,000 was invested in the five whole company Baldrige Award winners from the first day the company won the award (or went public) to October 3, 1994. The investment yielded a 188 percent return on investment compared to a 28 percent return for the Standard & Poor's 500, outperforming the S&P 500 by almost 6.5 to 1.

CONCLUSION

The Administration and Congress have expanded the nation's investment in NIST over the past two years while the total level of federally supported R&D has been held steady, or even reduced slightly. The total investment at NIST remains a very small percentage of the government's R&D program. The added investment at NIST is designed to bolster the support companies receive from an agency that has a long track record of working directly with and for industry—and delivering bottom-line value for taxpayers.

The priorities for our work are industry's priorities. We work in true partnerships with U.S. companies, small and large, to do the jobs that cannot be done separately.

Our major R&D funding effort, the Advanced Technology Program, is enabling technology development that is cost-shared, rigorously competed, and supportive of R&D work, always at the pre-product development stage.

By teaming up with state and local governments, our Manufacturing Extension Partnership is rapidly expanding services to smaller companies throughout the country.

Our laboratories are offering industry the benefits of stronger measurement research and services that underpin companies' R&D, manufacturing and sales.

The Malcolm Baldrige National Quality Award program is beginning to extend the principles of good business practices to our education and health care sectors.

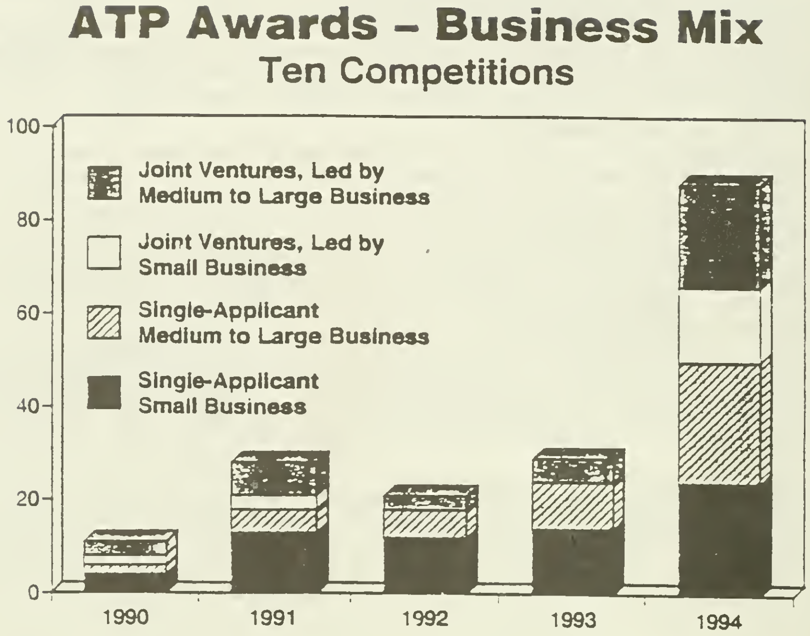
The scale-up challenges for our newer programs, the ATP and MEP, have been substantial. But we have had terrific engagement with industry in both cases. We have ensured that these programs are executed in a manner consistent with NIST's principles of technical excellence and objectivity. We are beginning to see the real fruits of this work, and we look forward to delivering even greater value and positive impacts for U.S. industry, our economy, and our taxpayers.

Senator BURNS. Thank you, Dr. Prabhakar, after I completely destroy your whole name. [Laughter.]

Dr. PRABHAKAR. You got it.

Senator BURNS. It is a wonder you come to work at all, or come before this committee. [Laughter.]

I appreciate your patience on that. Dr. Baker, who is director of NOAA, welcome.



STATEMENT OF HON. D. JAMES BAKER, UNDER SECRETARY FOR OCEANS AND ATMOSPHERE, DEPARTMENT OF COMMERCE

Dr. BAKER. Thank you, Mr. Chairman, Senator Rockefeller. I appreciate the opportunity to come and talk about the science and technology programs of the National Oceanic and Atmospheric Administration. I would like to share just a brief summary of the highlights of our atmospheric programs in the context of our strategic plan, and also give you an update on the status of weather service modernization. An expanded version of my comments is available for the record.

Let me say first of all that there is a great synergy between the agencies which are sitting here at the table, between NOAA and the technology administration NIST. We turn to NIST to give us an analysis of the economic benefits of the modernization program. They do studies of calibration for our atmospheric measurements, and they have been very valuable in DNA studies about fish. So there is a very close collaboration and synergy in the Commerce Department between the technology agencies.

As you know, our mission is to describe and predict changes in the earth's environment and to conserve and manage wisely the Nation's coastal and marine resources. As we look forward to the year 2005, 10 years from now, we act to provide knowledge for a world in which societal and economic decisions are coupled very strongly with a scientific understanding of the environment.

Over the last 25 years, technology and insights have allowed us to make major strides in understanding and predicting the behavior of natural systems, in managing resources more effectively, and in improving our environmental quality. NOAA sciences and services have played an important role in this process. Looking to the 21st century, we face evermore complex challenges. Today's investments in science and technology will revolutionize future services with return on investment through economic security and improvements in the quality of life.

We are committed to the continuing modernization of all of our technologies which underpin our capabilities to provide the best and most useful information. To prepare for the changing needs of the Nation, we established a strategic plan for the year 2005. Our strategic plan defines the goals to fulfill our vision of sound decisionmaking based on comprehensive understanding of the environment. The strategy has two main themes. One is environmental assessment and prediction, and the second is environmental stewardship. Our atmospheric and satellite programs are in our environmental assessment and prediction mission. Our mission here is to operate an integrated environmental observation, assessment and forecast service that enhances public safety, saves lives, and enhances the Nation's economic and environmental security.

Mr. Chairman, as you well know, our dynamic environment presents extraordinary challenges for protecting life and property. We have seen that with the storms in Montana. We have seen that with the California floods. And my wife brought in for me today the latest issue of the Herald Tribune, which says thousands flee ravaging floods. These are the kinds of problems that we face. Every year, we lose hundreds of lives and we face loss of property worth billions of dollars—hurricane Andrew was $25 billion—due to environmental events that could be predicted in advance. Our goal is to improve our short-term warning and forecast products by enhancing our abilities to observe and understand the environment and disseminating those products and services to users more effectively.

In terms of short-term warnings, we are implementing our goal by completing the modernization, by maintaining continuous satellite coverage, strengthening our prediction systems, and improving the application and dissemination of our products. Our research and development contributes to this goal by improving our basic understanding and developing new observational means. For example, the new GOES satellite monitors weather conditions 100 percent of the time, as compared to a 5 percent capability for previous satellites. It looks to higher latitudes, it gives better resolution, it allows us to track storms.

We are seeing important advances in warnings and preparedness. We hope that the accuracy of computer forecasts for severe storms can be moved up to 48 hours, to be as good as they are now for 24 hours. We look to warning lead times increasing from 15 minutes to 30 minutes for explosive storms. Our warning accuracy is moving from 60 percent to 90 percent. Our severe storm diagnosis, including the formation and evolution of hurricanes, tornadoes, and thunderstorms, will be improved. Hurricane predictions have in fact improved significantly with new computer modeling. Our availability of information such as temperature, winds, and water vapor in the atmosphere, will all be improved with new profiling technologies and our new GOES satellite.

We are also looking for better ways to use high technology to disseminate weather information throughout the country and the world, and use this more effectively with State and local governments and emergency planners. We are doing a better job of water resources management with our river forecast centers by extending and enhancing forecast lead times for floods and river rising. We are reducing the vulnerability to coastal hazards through improving our coastal forecast capabilities. For example, the benefits of a Great Lakes forecast system are being extended to marine coasts.

Second, we are achieving good success in implementing longer-term forecasts, as we discussed when we met earlier last week. The largest interannual or year-to-year climate change which has a degree of predictability is caused by the El Niño, phenomenon, which originates in the tropical Pacific. The temperature and rainfall patterns, changes in the ocean currents, and changes in storm frequency that are caused by this process, have global effects on economics and planning. We estimate a $3 billion effect on agriculture.

We are making good progress here in providing 1-year lead-time forecasts of known skill of global climate variability. We are delivering useful forecasts, enhancing our observing systems, investing in computer modeling to improve predictions, and we are assessing the impact of climate variability on human activities and economies. We just completed deployment of a new tropical ocean observing system in the tropical Pacific that will provide information vital to developing the predictions of this year-to-year change.

This month, the National Weather Service Climate Prediction Center has begun issuing monthly and seasonal probability outlooks for temperature and rainfall up to a year in advance. Previously, climate predictions have been made only for a 90-day period. This capacity is the direct result of our climate and global change research program and the development of new techniques. The drought of 1988, the Midwest flood of 1993, and the loss of returning salmon on the Northwest have all been linked to climate shifts. If we could do a better job of predicting these, we have a way of mitigating these changes. We expect that by early in the 21st century we will have the capability to produce multiseason forecasts of rainfall with accuracies approaching those of today's short-term forecasts.

Third, we are working on longer time-scales: tens to hundreds of years. We know that the planet is naturally a place of change, often with severe human impacts. Human activities are inducing additional changes, including atmospheric pollution, the thinning of the stratospheric ozone layer, and land-use change. NOAA provides science-based information for decisions regarding decadal to centennial changes, specifically for global climate change, ozone layer depletion, and air quality improvement. This is important. To mitigate the effect of emissions that cause greenhouse warming could cost up to $5 trillion. If we can provide some science-based information that tells us how we can do that best, we have an enormous impact on the economy of the country and of the world.

NOAA's work on stratospheric ozone is providing input to assessments made in international policy. NOAA scientists were prominent in developing the theory of ozone depletion in the Antarctic, and are looking at the ozone effects of proposed chemical substitutes. Choosing the right substitutes will save the industry $25 million. This is an enormous impact. We are also providing the basis for forecasts for long-term change, with predictions of sufficient scientific credibility to support government and industrial decisions.

Mr. Chairman, let me conclude with just a few remarks about the National Weather Service modernization. As you know, we are well on our way to completing the largest modernization and associated restructuring of our service in the Weather Service history; in fact, in the history of any weather service in the world. This is true reinvention of Government. The Weather Service is using advanced technology, and capitalizing on progress in science to improve efficiency. The modernization will revolutionize the quality and reliability of products and services.

The return on the investment is exceptional. NIST has shown us that the economic benefits are eight times greater than the costs to modernize. In fact, based on NOAA expenditures for the provision of climate and weather services, the annual cost to each U.S. citizens for these services is about $4 a person. We just put in our 100th doppler radar. By the end of 1995, we will have installed 133 of 163 NEXRAD radars. We will have acquired 108 of 118 weather forecast offices. We will have installed 628 of 800 automated surface observing systems. And we will have launched the second GOES, GOES 9, and our other polar orbiting satellite, NOAA 14. And we will have completed the staffing of the next generation radars for 98 of the 118 weather forecast offices.

In modernizing, we will phaseout nearly 200 offices. The offices are being replaced with 118 new facilities, staffed with better trained employees using state-of-the-art weather technology in about 13 river forecast centers. In 1994, in fact, we certified our first relocation of a weather service forecast office in California.

The National Academy of Sciences is monitoring this modernization. The Academy has been instrumental in developing criteria which the Weather Service uses for modernization actions. In addition, the Modernization Transition Committee provides guidance and recommendations for the Secretary of Commerce.

In general, as the Secretary said earlier, the modernization is progressing well. New systems have been meeting or exceeding their expectations. We have been working on a schedule to make sure that our advanced weather interactive processing system is deployed on a schedule beginning in 1997. AWIPS, as it is called, is the interactive weather computer workstation system that will integrate satellite and radar data for the first time, and provide local weather offices with advanced forecasting capabilities.

During 1994, a team of experts completed an extensive independent assessment of all the development for this program and its acquisition activities. Recommendations resulted in a restructuring of the program, and we are now renegotiating the development phase contract.

We continue to consult with the Federal Aviation Administration regarding augmentation of the automated surface observing system at airports. We agree that augmentation is required, at least for some period, and it is currently under review how we carry that out. We are eager to get this resolved in the near term.

We are looking to improve warning and forecast capabilities out to 7 days. One-year outlooks of temperature and rainfall have been initiated. Capabilities now exist to issue severe weather warnings with 15 minutes lead time compared to the recent zero to 5 minutes, and our warning accuracy has improved from 40 to 70 percent. Full deployment of these new technologies and computer systems will further enhance the quality of services to the Nation.

Let me see the one figure we have of the radar system in the California flood, which I think is a nice example of our current capabilities, Mr. Chairman. This shows the rainfall during the California flood period. The nice thing about the new radar system is it gives us information in real time exactly where the rain is falling, and how the systems are moving, so that the local forces on the ground can make decisions about where best to deploy people, where to move people out in case there is flooding, and so on. This is a very nice example of the combination of new technology and new warning systems to provide the kind of information that we need to save lives and to protect property.

Now, throughout our history NOAA's role has been to warn of danger, protect life and property, predict environmental changes in time and space, and provide decisionmakers with reliable scientific information. As we look 10 years from now, we believe that this mission and our vision benefits the country. Our research and services provide an equal measure for the future. There is no other agency in the natural environment that has NOAA's responsibility for measurement, monitoring, and understanding of the atmospheric and marine systems. These are core businesses of the Government, including functions which have highly concentrated costs and widely dispersed benefits, a true public good, such as the provision of whether warnings and forecast information supplied by NOAA increasingly is critical in protecting the life, health, and property of our citizens and developing a new sustainable relationship with our environment and its resources.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Baker follows:]

PREPARED STATEMENT OF DR. D. JAMES BAKER

INTRODUCTION

Thank you, Mr. Chairman, and members of the Subcommittee, for this opportunity to testify on the science and technology programs of the National Oceanic and Atmospheric Administration (NOAA). As the Subcommittee has requested, my remarks will include a discussion of NOAA's current and future atmospheric programs, and an update on the status of modernizing the Nation's weather services. The central theme for this discussion is NOAA's Strategic Plan for the year 2005. I would also like to talk about how NOAA is advancing the Department's, and the Administration's, agenda for sustainable development.

NOAA's mission is to describe and predict changes in the Earth's environment, and conserve and manage wisely the Nation's coastal and marine resources to ensure sustainable economic opportunities. For the year 2005, NOAA will provide knowledge for a world in which societal and economic decisions are coupled strongly with a comprehensive understanding of the environment.

Over the past 25 years, technology and scientific insights have allowed us to make important strides in understanding and predicting the behavior of natural systems, managing resources more effectively, and in improving environmental quality. NOAA sciences and services have played an important role in this evolution. As we approach the 21st century, we face continuing and complex environmental challenges. Investments in science and technology will revolutionize these national services, with returns on investment through economic growth and improvements in the quality of life.

NOAA AND SUSTAINABLE DEVELOPMENT

By addressing existing and future environmental challenges, NOAA works as an integral part of the Department of Commerce to further the Nation's capabilities for sustainable development. As Secretary Ronald Brown states in *To Ensure the Nation's Future: Sustainable Development and the U.S. Department of Commerce,* "Economic growth can—and must—go hand in hand with environmental stewardship. The development of policies that strengthen the links between environmental stewardship and economic growth is central to the Administration's agenda and is a core concern of the Department of Commerce."

Embracing this linkage between economic and environmental goals has been a guiding principle in NOAA's planning and mission evaluation efforts. Sustainable development is necessary to preserve national security in a world of constant change, and is critical to ensure economic opportunities in the long term. In order to promote sustainable development, NOAA will be guided by four priorities:

- Integrating environmental stewardship and economic development: Without a healthy and predictable environment, economic development cannot be sustained, and the quality of life for all citizens would suffer. NOAA's, and the Department's unique role, is to combine this capacity under one roof. The activities being implemented through NOAA's Strategic Plan strongly support sustainable development in a rapidly changing world.
- Redefining the relationship between the Federal government, state and local governments and stakeholders: NOAA will review and rework the ways in which we address many of our responsibilities. We are working with governments, groups and individuals to develop effective partnerships for addressing common needs and providing realistic solutions. Our Coastal Zone Management and National Sea Grant programs are vibrant examples of such partnerships.
- Reinventing the way government does business: NOAA is committed to creating a government that works better and costs less. For instance:

  NOAA is implementing a streamlining plan that reduces the workforce and decentralizes decision making power. Pursuant to the Federal Workforce Restructuring Act of 1994, NOAA must reduce its workforce by 16 percent from the FY 1993 base level to meet its FY 1999 full time equivalent (FTE) ceiling of 12,012. This will require the elimination of 2,297 FTEs through phased annual reductions.

  NOAA has volunteered to be a pilot agency under the Government Performance and Results Act, and has been commended by the National Academy of Public Administration Review Panel and selected by the Office of Management and Budget as one of ten government-wide exemplars. Currently, NOAA is refining its performance measures and working to institutionalize the values of customer responsiveness and results oriented management.

  NOAA is implementing actions to utilize resources more efficiently, such as: converging Department of Defense and NOAA polar-orbiting environmental satellite systems; modernizing the National Weather Service; leveraging data acquisition through the creation of global partnerships; and contracting for certain marine data and services. Satellite convergence alone is expected to result in over a billion dollars in savings to the taxpayer—as compared with the combined cost of independent systems.

  NOAA co-chairs the National Science and Technology Council's (NSTC) Committee on Environment and Natural Resources (CENR). CENR is coordinating a multi-disciplinary environmental and natural resource R&D strategy that will provide the scientific and technical information needed for national and international policy formulation and implementation. Through the interagency mechanism of CENR, which includes the input of over 200 nongovernmental experts, the Administration has improved the prioritization of programs and funding. The near-term priority areas identified by the NSTC are: improving the scientific basis for integrated ecosystem management; understanding the socioeconomic dimensions of environmental change; developing science policy tools; improving observations, information and data management; and environmental technologies.
- Providing the environmental information needed by policymakers for decisions: NOAA is an information agency. Our products and services pervade the daily personal and business life of every American. By the year 2005, all NOAA environ-

mental data and information products will be readily available to the Nation. NOAA information will be disseminated as part of the National Information Infrastructure. Products and services will be made available by nationwide networking connectivity at high data rates using advanced information technology. NOAA's system of environmental information services will form an important link in the chain leading to informed policy decisions.

NOAA is defining and examining the programs and goals necessary to address most effectively these challenges. We are committed to the continuing modernization of our technologies, which underpin our capabilities to provide the best and most useful information. To anticipate and prepare for the changing needs of the Nation, NOAA has established a Strategic Plan for the year 2005.

NOAA'S STRATEGIC PLAN

NOAA's Strategic Plan for 1995–2005 defines the goals necessary to fulfill our vision of sound decision making based on a comprehensive understanding of the environment. The plan transcends internal organizations, and promotes synergy, innovation, cooperation and efficiency. The program strategy consists of seven inter-related goals. The seven goals are grouped under our two primary missions of *Environmental Assessment and Prediction* and *Environmental Stewardship.*

At the Subcommittee's request, I will focus on NOAA's atmospheric (weather and climate) programs, which reside primarily within the Environmental Assessment and Prediction Mission. For the Subcommittee's convenience, a synopsis of NOAA's Environmental Stewardship Mission also is presented.

Environmental Assessment and Prediction Mission. For the year 2005, NOAA will operate an integrated environmental observation, assessment, and forecast service that enhances public safety and the Nation's economic and environmental security.

Goal: Advance Short-Term Warning and Forecast Services. Our dynamic environment presents extraordinary challenges for protecting life and property. Each year, hundreds of lives and billions of dollars are lost due to environmental events that could be predicted minutes to months in advance. NOAA's goal is to improve significantly its short-term forecast and warning products by enhancing abilities to observe, understand and model the environment, and by disseminating products and services to users more effectively.

NOAA's current ability to predict short-term environmental change accurately is restricted by observations that are incomplete in both time and space. This limits the ability to improve basic understanding, and hence predictive modeling of the environment. Although we can do nothing to prevent natural disturbances, we must do everything possible to minimize their human impact.

To advance short-term warning and forecast services, NOAA must: (1) complete the modernization and restructuring of the National Weather Service; (2) maintain continuous operational satellite coverage; (3) strengthen environmental observing and prediction systems; and (4) improve the application and dissemination of products and services to the public.

Improved warnings and forecasts will benefit nearly every sector of the American economy and the general public. Better information will enable advanced stewardship and management of inland and offshore water resources, and help avoid unnecessary flood damage. Improved forecasts of solar and geomagnetic disturbances will increase efficiencies for space operations, and power generation and satellite communications networks. Accurate outlooks of future environmental conditions (beyond a few days) will provide planning information for weather sensitive activities over both land and ocean.

The National Weather Service is in the midst of a modernization of its observing technology, data and information systems, and service delivery. Much of the Modernization is built upon NOAA research—Doppler radar technology, next generation satellites, and information processing and display systems. Atmospheric programs associated with the Modernization are treated in greater detail in the next section of this testimony entitled, "Status of National Weather Service Modernization."

NOAA research and technology contributes to the goal of advancing short-term warning and forecast services through improving basic hydrometeorological understanding and the development of new observational technologies. An example of improved technology is the GOES satellite's ability to monitor weather conditions 100 percent of the time, as compared with a 5 percent capability for previous satellites.

NOAA is leading an interagency effort to understand better the formation and evolution of tornadoes and severe storms. The second phase of the Verification of the Origin of Rotation in Tornadoes Experiment (VORTEX) will be conducted this spring. The improved understanding gained from this project will eventually lead to short-term forecasts of severe weather, in addition to improved warnings.

Information on the temperature, winds, and humidity through all layers of the atmosphere is crucial input to weather forecast models. NOAA researchers are exploring ways to more effectively obtain this information. A wind profiler demonstration network in the Midwest remotely obtains wind speed and direction through the atmosphere. This information has contributed to the improvement of weather forecasts. Research on remote sensors for temperature and humidity continues and scientists are investigating ways to integrate all available data—from in situ sensors, remote sensors, and satellites—to obtain a comprehensive picture of the atmosphere.

Forecasts are based largely on guidance from numerical models. Improvements in the predictive capability of models will improve overall forecasts. NOAA has developed a hurricane prediction system that has significantly reduced hurricane track forecast errors and captures changes in intensity. This research model is being tested operationally, with much success. Better hurricane track forecasts have the potential to save lives and to reduce evacuation costs—estimated at hundreds of thousands of dollars per mile of coastline evacuated.

NOAA is developing prototype weather dissemination systems to aid in determining how critical weather information might be disseminated and used by state and local governments. These prototypes are being tested by local governments, emergency managers, and National Weather Service forecasters.

An improved water resources forecast system (WARFS) will provide better weather, hydrological, and water resource information that are critical to water managers and planners, by integrating historical and real-time data to extend and enhance forecast lead times. Improving lead times will enable decision makers to take effective actions to mitigate the impact of major floods and droughts.

Much of the research I just described contributes to the NOAA-led U.S. Weather Research Program. This multi-agency program is designed to improve weather prediction and the dissemination of weather information.

Weather research is just one aspect of NOAA's short-term forecast and warning effort. NOAA also is seeking to improve its "space weather" services by obtaining data from other agency research missions to use in an operational context. These data will lead to advance warnings of geomagnetic storms. NOAA is working with other agencies to develop a National Space Weather Program, a mechanism for coordinating research activities aimed at improving space weather services.

In the coastal arena, NOAA's Coastal Ocean Program (COP) is improving the accuracy of NOAA's forecasts and warnings of hazardous conditions in coastal waters through advanced techniques for modeling extra-tropic storm surge forecasts, tsunami inundation, and winds over the coastal ocean and Great Lakes. The COP also is developing a new coastal forecasting capability based on enhanced observations, understanding, modeling, and two-way communication of needs and results with coastal communities and customers. A Great Lakes Forecast System was the first regional effort to benefit from these improved services that are now being extended to the U.S. marine coasts.

Goal: Implement Seasonal to Interannual Forecasts. The largest interannual climate variability which has a degree of predictability is caused by the El Niño-Southern Oscillation (ENSO) phenomenon. Temperature and precipitation patterns, changes in ocean circulation, and changes in storm frequency caused by ENSO have global effects on economics and planning. NOAA's goal is to provide one-year lead-time forecasts of known skill of global climate variability, especially El Niño and the consequent precipitation and surface temperature distributions, to a society that responds to the forecasts so as to increase its economic advantage and to mitigate against economic losses and social disruption.

To implement seasonal-to-interannual climate forecasts, NOAA must: (1) deliver useful forecasts and information; (2) enhance observing and data systems; (3) invest in process and modeling research leading to improved predictions; and (4) assess the impact of climate variability on human activity and economic potential.

NOAA research activities include: process studies to understand mechanisms of seasonal to interannual climate changes and their impacts regionally; development of observing systems; and modeling and prediction efforts. Process studies are focused on the evolution of the ENSO in the atmosphere and ocean and how the ENSO affects regional patterns of temperature and precipitation.

NOAA has just completed deployment of the Tropical Atmosphere Ocean Observing System, a series of instrumented buoys across the tropical Pacific. This system will provide information on the atmosphere and ocean vital to developing predictions of interannual climate variability.

Modeling studies are providing insight into the predictability of seasonal to interannual climate changes. This month, the National Weather Service Climate Prediction Center has begun issuing monthly and seasonal probability outlooks for temperature and rainfall for up to a year in advance. Previously, climate predictions have been made only for a 90-day period. This capacity is the direct result of the research performed over the last decade on the ENSO phenomenon and development of key new observing capabilities.

Seasonal forecasts will lead to immediate economic benefits, especially in the agriculture and water resource management sectors. The drought of 1988, the Midwest flood of 1993, and the loss of returning salmon in the Northwest have been connected to climate shifts on a seasonal to interannual timescale. By the year 2015, we should have the capability to produce multiseason forecasts of precipitation with accuracies approaching those of current short-term forecasts.

Goal: Predict and Assess Decadal to Centennial Change. Our planet is naturally a place of change, often with severe human impacts. Human activities now are inducing additional changes, with potential impacts of comparable magnitude. Human-induced changes observed on decadal time scales already are evident, including atmospheric pollution and thinning of the stratospheric ozone layer. Greenhouse gases being added to the atmosphere will reside there for decades to centuries and are predicted to increase average global surface temperatures by several degrees Celsius—a change larger than the natural variation over the last 15,000 years. These changes create critical prediction and assessment needs for the world community. NOAA's goal is to provide science-based options for decisions regarding decadal to centennial changes in the global environment, specifically for: global climate change; ozone layer depletion; and air quality improvement.

To predict and assess decadal to centennial change, NOAA must: (1) characterize the agents and processes that force climate change; (2) examine the role of the global ocean in influencing change; (3) ensure a long-term climate record; (4) guide the rehabilitation of the ozone layer; (5) provide the scientific basis for improved air quality by determining how and why air quality changes and understanding the formation of surface ozone in rural areas; and (6) develop predictive models, scientific assessments, and human impacts information on long-term change.

NOAA research on the stratospheric ozone layer provides significant input to international assessments used in making international policy. NOAA scientists were prominent in developing the theory of stratospheric ozone depletion over Antarctica. Working with industry, NOAA scientists also investigate the chemistry of proposed substitutes for ozone depleting chemicals for their impact on stratospheric ozone. Their findings have influenced corporate decisions on substitutes in which to invest.

NOAA research on climate change will provide the basis for forecasts of decadal and longer changes with predictions of sufficient scientific credibility to support governmental and industrial decisions. NOAA research results are prominent in the scientific assessments produced through the intergovernmental Panel on Climate Change. NOAA's research strengths include long-term monitoring of greenhouse gases, like carbon dioxide; modeling studies to quantify the response of climate to changes in the levels of greenhouse gases; and determination of the ocean's role and influence on long-term climate change.

NOAA's air quality research provides a scientific basis for effective emission control strategies, which can help reduce the possibility of overregulation. NOAA is providing an understanding of high surface ozone events in rural areas, which can damage crops and forests. This research will lead to more effective approaches to controlling surface ozone, avoiding overregulation and the associated costs of control strategies. NOAA is now implementing a regional monitoring network to detect air quality change, with the aim of understanding how and why change is occurring.

Anticipatory research on climate change supports sustainable development by enabling society to make sound decisions to: (1) mitigate and adapt to climate change; (2) assess the utility of our large investment to reduce greenhouse gas emissions; and (3) to improve regional air quality. Scientific assessments are based on predictions whose credibility rests upon careful observations and understanding of key Earth-system processes. Formulating and carrying out research, presenting results in up-to-date assessments, and describing the implications in policy-relevant terms to government and industrial leaders are cornerstones of environmental stewardship. The benefits to the Nation and the world can be enormous. A clearer picture of the relative roles of various greenhouse gases in causing global warming will support implementing and sustaining a policy on stabilizing anthropogenic greenhouse gas emissions, estimated to cost $5.1 trillion globally. Assisting industry to choose the most "ozone-layer friendly" substitutes for chlorofluorocarbons will allow aggressive protection of the stratospheric ozone layer while continuing economic development. Information supporting Clean Air Act decisions that could reduce both urban and rural ozone will be developed, with benefits to agriculture and human health. This effort will support the information needs of the Montreal Protocol, the U.S. Clean Air Act, and the U.N. Framework Convention on Climate Change.

Environmental Stewardship Mission. For 2005, NOAA envisions U.S. ocean and coastal areas with healthy ecosystems and wise human use and development of ocean, coastal and living marine resources.

Goal: Build Sustainable Fisheries. NOAA's goal is to increase greatly the Nation's wealth and the quality of life through a sustainable fishing industry that provides safe and wholesome seafood and recreational opportunities. Billions of dollars in economic growth; thousands of jobs and countless recreational fishing opportunities are being wasted as a result of over fishing and overcapitalization in commercial and recreational fisheries.

To build sustainable fisheries, NOAA must: (1) assess the status of fishery resources; (2) advance fishery predictions; (3) manage for economic growth by developing plans for reducing excessive fishing and capital investment; (4) ensure adequate compliance; and (5) assist the industry during stock rebuilding periods.

Current investments in biotechnology, sampling technology, and ecosystem dynamics research will make a significant difference in how NOAA addresses this rebuilding. Restoring fisheries will promote the economic and biologic sustainability of U.S. fishing resources, and ensure that the commercial and recreational fishing industries are more competitive internationally. Better understanding and knowledge leads to sustainable fisheries and enhanced economic opportunity for the country.

Goal: Recover Protected Species. NOAA's goal is to ensure sustained progress in recovering marine species threatened with extinction and to protect the habitats and ecosystems upon which they depend. Many commercial and recreational activities contribute to adverse stress on marine species. Insufficient data makes it difficult to assess the problem, but many populations of marine organisms are depleted or declining due to human activity in marine ecosystems or to unknown causes.

To recover protected species, NOAA must: (1) assess the status of, and impacts to, protected species; (2) reduce the adverse impact of human activity on protected species; (3) develop and implement conservation and recovery plans for depleted marine mammals and endangered and threatened species; and (4) prevent future listings by engaging in multispecies ecosystem management.

Recovering species, and avoiding the further decline of others, will contribute to the overall health and understanding of marine ecosystems, as well as enhance economic and social opportunities for future generations.

Goal: Coastal Ecosystems Health. NOAA's goal is to ensure that development and conservation of the Nation's coastal ecosystems is managed in ways that maintain their biodiversity and productivity for sustained use. Rapid population growth and increasing demand for recreation and economic development in many coastal areas has degraded natural resources and led to declines in both environmental quality and economic productivity.

To sustain healthy coastal ecosystems, NOAA must: (1) integrate coastal ecosystem management through a watershed-based framework; (2) assess present and future ecosystem conditions; (3) monitor indicators of coastal ecosystem health; (4) understand and predict coastal ecosystem functions; and (5) improve public understanding of the value of coastal ecosystems, facilitate technology transfer and provide training for managers.

Atmospheric research contributes to our understanding of coastal ecosystem conditions as well as coastal weather and climate related processes. The Coastal Ocean Program is conducting research to estimate the magnitude and extent that air-borne nutrients and toxics contribute to the total contaminant loads in coastal waters. Initial estimates for the Chesapeake Bay, for example, indicate that 30–40 percent of nitrogen loading is derived from the atmosphere. NOAA efforts have focused on improved collection and analysis of wet deposition estimates in the Chesapeake Bay watershed. Future efforts move the focus to improvements in the monitoring and assessment of dry deposition estimates.

Maintaining coastal ecosystem health and biodiversity is essential to sustainable development of coastal resources and an important part of maintaining the health and welfare of the Nation.

Goal: Modernize Navigation and Positioning Services. NOAA's goal is to meet the Nation's needs for the next decade's marine and aeronautical navigation systems that electronically integrate accurate chart data, global positioning system-based locations, and real-time environmental information. NOAA's capabilities for ensuring safe and efficient marine and air navigation, and positioning services are in need of modernization.

To modernize navigation and positioning services, NOAA must: (1) provide marine and aeronautical navigation systems that electronically integrate accurate chart data, GPS-based positioning, and real time environmental information; and (2) renovate the Nation's geodetic reference system to support full use of GPS for navigation and positioning.

Accurate positioning, charts and navigation services are essential components of the national infrastructure. This effort will: foster the development of technologies for air and marine navigation, surveying, positioning, and management of geographic information; expand export opportunities; promote sound environmental stewardship by providing basic planning, environmental, and geographic information for management decisions; and reduce risks to life, cargo, and property.

NATIONAL CAPABILITIES AND SUPPORTING INFRASTRUCTURE.

In support of the two strategic missions, NOAA's program strategy depends on our capabilities as a national resource for research, observational systems, and environmental data and information services; and on our supporting infrastructure. NOAA must continue to invest in these capabilities, which serve as the foundation of our programs. For instance, NOAA must guard against technological obsolescence, adequately maintain facilities and equipment, capitalize on technological improvements which reduce costs and improve performance, and ensure the selection of competent employees and the continuing education and training of experienced personnel. We must seek to implement an integrated global observing capability that effectively combines both satellite and in-situ measurements. At the same time, we must ensure that data are processed, analyzed, and distributed in a timely fashion.

STATUS OF NATIONAL WEATHER SERVICE MODERNIZATION

General. NOAA's National Weather Service (NWS) is well on its way to completing the largest Modernization and Associated Restructuring (MAR) in its history. Weather service modernization is reinventing government. The NWS is using advanced technology, and capitalizing on progress in science, to make the government more efficient in the provision of services. To ensure protection of life and property, the MAR will dramatically improve the quality and reliability of NWS products and services. The return on this investment in new technology is exceptional. The economic benefits to the Nation are about eight times greater than the costs to modernize. Substantial quantifiable benefits accrue to various segments of the U.S. economy such as aviation, agriculture construction, and transportation.

The NWS has installed over 100 new weather surveillance radars (NEXRADs) and has completed construction for most of the new Weather Forecast Offices (WFOs). In the course of the modernization, the NWS will phase out and eventually close about 200 NWS offices. These offices are being replaced with 118 new facilities, staffed with better trained employees using the latest state-of-the-art weather technology. Staffing of those new offices is in progress. Over the last year, the NWS has certified its first relocation of a Weather Service Forecast Office in California. The user community that was first wary of the relocation is now enjoying more accurate and timely forecasts from the new office.

The NWS modernization is being monitored by the National Academy of Sciences' (NAS) National Research Council. NAS has been instrumental in developing criteria which the NWS uses for each certifiable action needed during the modernization. In addition to the NAS, the Modernization Transition Committee also provides guidance and recommendations to the Secretary of Commerce during the modernization process.

A way in which this modernization may be accelerated and save costs is a revision of Public Law 102–567. We would like to work with Congress on improvements to current law to achieve those objectives.

Status of Systems. New technologies are at the heart of the modernization. The status of each of the major systems is described below:

- *NEXRAD.* As the cornerstone of the NWS Modernization program, the advanced NEXRAD doppler radar is required to replace the current obsolete weather radars by providing data for more timely and accurate weather and flood warning and forecasts. The tri-agency radar program is currently in the final stages of full-scale deployment. After the NEXRAD contract was renegotiated in FY 1992, the program has met all major schedule milestones. By the end of FY 1995, 133 out of a total of 163 systems will be deployed. The remaining radars will be delivered in FY 1996. In FY 1995, final hardware and logistics acquisition portions of the program will be completed. Beginning in FY 1995, the program emphasis will shift to operational support and system improvement efforts. In terms of performance, the radars have received very positive feedback from both the weather community and the public.
- *ASOS.* ASOS is a key element of the NWS modernization and also supports the FAA and DOD modernizations by automating their respective surface weather ob-

servations programs. ASOS automates and significantly enhances the current, largely manual, methods for collecting, processing, displaying, and storing surface weather observations. The program presently is in the full-scale deployment phase. By the end of FY 1995, 628 out a total of 868 ASOS units will be installed at sites around the country. Final ASOS units will be installed in FY 1996/97. In FY 1996, the program emphasis will shift to system improvement and operational support issues.

NOAA continues to consult with the Federal Aviation Administration (FAA) regarding augmentation of the Automated Surface Observing System (ASOS) at airports. NOAA and the FAA agree that, for some period, augmentation is required. The means for ensuring such augmentation currently is under review, and must be resolved in the near term.

- *AWIPS.* AWIPS is the interactive computer workstation that will integrate satellite and radar data for the first time and provide the local weather offices with an advanced forecasting system. In FY 1994 significant problems surfaced between the Government and the prime contractor, PRC, Inc. A team of experts completed an extensive independent assessment of all AWIPS development and acquisition activities. Recommendations resulted in a proposed restructuring of the program. Major aspects of the restructuring effort include: designing a system that will allow AWIPS to evolve as technology or requirements change; deploying an early AWIPS capability system to validate system features in an operational setting; enhancing AWIPS capability through a series of incremental software upgrades; and continuing to involve the user community in the development, review and validation of AWIPS. Preparations are underway to begin renegotiation of the development phase contract.
- *Central Computer Facility Upgrade.* The NOAA Central Computer Upgrade, begun in FY 1990, will lead to more accurate and more specific forecasts of major storms including hurricanes, thunderstorms and floods, and will enable more accurate general weather forecasts in the medium (3–10 day) and extended (30 day) ranges. During FY 1994, the Class VII system was installed, and testing of experimental ensemble forecasting and an experimental version of the GFDL hurricane model was initiated. Backup capability to the Class VII is provided through a 5-year lease of two J–916 systems. These systems serve also as additional processing capability for climate analysis.

Continued improvements in centrally prepared weather guidance products for day 2 and beyond are essential to successful implementation of mesoscale forecasting in NWS field operations.

- *GOES Satellites.* Our geostationary program is approaching it's original configuration of GOES-East and GOES-West. GOES 7 has been repositioned to 135 degrees West and is healthy. This move will reestablish our western GOES position. GOES 8 our newest geostationary satellite, will be repositioned to 75 degrees West in February. GOES 8, with its advanced system capabilities, has been exceeding our expectations in providing information for our warning and forecast requirements. On May 23, we will launch GOES J (9), which will be placed at the westerly position currently occupied by GOES 7. This will bring us to our original two GOES constellation. GOES J has completed all of its tests and is ready to be shipped to the Cape for the launch in May.
- *Polar Satellites.* The polar satellite program provides continuous global monitoring of the Earth and supports NOAA/NWS, NOAA/NMFS, DOD, FAA, and international users. The polar system is supported by NESDIS research in the areas of atmospheric, oceanic, land, and cryospheric applications development; atmospheric calibration and product validation.

Our polar program is healthy. We achieved a successful launch of NOAA–14 on December 30, 1994. We have just completed activating and testing the various systems and sensors. All are functioning as expected. The first visible image was received on December 30, a few hours after launch. The full set of products from NOAA–14 will be available by late March after final calibration and fine tuning of ground processing software. All other satellites in this series are on track, with the next launch scheduled for April 1996. Contracts for the N and N' spacecraft were awarded on December 16, 1994. This will complete the satellite acquisition until the time frame of the first converged satellites.

- *WFO Construction.* The Weather Forecast Office Construction Program provides for the construction of 118 weather forecast offices that provide a state-of-the-art environment to house the new technology systems and weather office personnel. By the end of the FY 1995, the WFO Construction Program will have either built or leased 108 WFOs out of a total 118 scheduled for construction. The final forecast offices are scheduled for completion in FY 1996–1997. The program emphasis in the FY 1996 will shift to completing the remaining construction activities and focusing on maintenance issues for the new offices.

- *Polar Convergence.* As a result of Vice President Gore's National Performance Review, in February 1994, a triagency group of experts was tasked to review polar-orbiting—meteorological satellite programs and develop a plan to achieve convergence. The agencies participating included the Department of Commerce (NOAA), DOD, and the National Aeronautics and Space Administration (NASA).

On May 5, 1994 the President issued Presidential Decision Directive NSTC–2 directing Commerce and Defense to combine the existing Defense Meteorological Satellite Program (DMSP) and the NOAA Polar-orbiting Operational Environmental Satellite (POES) Program into a single National Polar-orbiting Operational Environmental Satellite System (NPOESS), in accordance with the triagency developed plan. NASA was directed to become part of the effort by examining areas where aspects of its Earth Observing Satellite (EOS) system might improve the capabilities or reduce costs of the new system.

An Integrated Program Office (IPO) was established on October 3, 1994, to develop, acquire, operate and manage the project. NOAA was given overall responsibility for the converged system and the lead role for satellite operations. The Department of Defense was given lead agency responsibility to support the IPO through major systems acquisitions necessary to the NPOESS. NASA was given lead agency responsibility to support the IPO in facilitating the development and insertion of new cost-effective technologies that may enhance the ability of the converged system to meet its operational requirements.

This three satellite constellation will replace four on-orbit satellites currently used by DMSP and POES. Short-term (1995–1999) savings achieved by having one, as opposed to two development programs may be up to $300 million. NOAA will procure two satellites (NOAA N & N') to fill the gap in polar coverage until the NPOESS has been developed and deployed. Continuing high-level contacts with the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) have shown strong European interest in a long-term joint polar satellite system that would include the planned European Polar Satellites and NPOESS. Negotiations to meet U.S. requirements are at an advanced stage with finalization of an agreement expected later this year.

Status of MARDI/Staffing (Modernization and Associated Restructuring Demonstration and Implementation). The MARDI program provides for the interim staffing augmentation necessary during the NWS Modernization and support the certification requirements associated with office closures and relocations outlined in Public Law 102–567. The interim staffing augmentation covers the cost of personnel at the new offices while at the same time ensuring no degradation of service occurs at the existing weather offices. In addition, the program also covers the cost of personnel transfers and an extensive scientific education program to train weather office personnel. The MARDI staffing profile divides into two major stages. The first stage (Stage I) is to staff offices to operate the NEXRAD radars. The second stage (Stage II) will provide staff to operate the AWIPS workstations. By the end of 1995, Stage I staffing will be completed for 98 out of a total of 118 offices. Stage II staffing is scheduled to begin after the deployment of the AWIPS systems. Other costs associated with the NWS Modernization are covered by MARDI including the Modernization Transition Committee, NOAA Weather Radio Console Replacement System (CRS), and other costs associated with certification and transition management.

Expected Improvements in Warning and Forecast Abilities. The accuracy of today's standard 1 to 3 day forecast is better than the outlook period of 4 to 6 days. However, by capitalizing on current and emerging technologies in concert with developing new scientific techniques, accurate forecasts of up to 7 days will be common.

Similarly, today's standard outlook of 6 to 10 days will increase to 8 to 14 days. As noted earlier, NOAA has begun issuing long lead outlooks of temperature and precipitation of up to 12.5 months in advance.

The MAR has provided the capability to regularly issue severe weather warnings with a minimum of 15 minutes lead time as compared to the 0 to 5 minutes of the recent past. Warning accuracy using the new technologies has improved from 40 to 70 percent. Continued improvement is envisioned using the full deployment of the new technologies and with the delivery of AWIPS to integrate these many data sources and provide the forecaster with the tools necessary to produce all NWS products and services.

The accuracy of computer forecasts for severe convective storm potential will be as good for 48 hours as they are now for 24 hours. Warning lead times will increase from today's new standard of 15 minutes to 30 minutes—and this will be true not only for severe thunderstorms and tornadoes, but also for flash flooding. Warning accuracy will improve from 60 percent to 90 percent.

Preliminary studies suggest that a 20-percent improvement in hurricane track prediction is possible with the use of new sensing systems aboard the new reconnaissance aircraft in concert with data from the new GOES sounder. NEXRAD will improve warnings for the inland effects of hurricanes including flooding, embedded tornadoes, downbursts, and extreme winds.

Notification. The NOAA Weather Wire System and NOAA Weather Radio will continue to be the primary dissemination systems to the media, emergency managers, and the general public. As part of AWIPS, the new NOAAPORT will provide upgraded quality and quantity of data, forecasts and graphics.

NOAA Weather Radio is the direct link to the public 24 hours a day, 365 days a year. Now, with the latest technical advances, weather warnings will automatically enter the Federal Communication Commission's new Emergency Alert System (EAS). The EAS will use the transmission services of the 24,000 radio, television, and cable television facilities in the United States.

In addition, like the current NOAA Weather Radios, AM or FM radios and televisions in the future will have the capability of being automatically "turned on" by the NOAA Weather Radio system during severe weather and other emergencies. This is a major step in the agency's mission to provide warnings to save lives and property.

Our goal is to decrease the number of lives lost because a warning was not received.

OTHER ISSUES

Before closing, I would like to address two important matters.

First, we are concerned by S. 219, the Regulatory Transition Act of 1995. This bill would establish a moratorium on any new Federal rulemaking actions until July 1, 1995. Our management of the Nation's fisheries would be harmed by this proposal, since it would allow fisheries to remain open beyond the closing dates that are needed to restore depleted fishery resources. We rely upon the exercise of these same rulemaking provisions to solicit cooperative input from local officials and private citizens in managing our National Marine Sanctuaries, yet this proposal would bar that constructive process. Two categories of pending regulations that could be affected by the moratorium in S. 219 include:

(1) Proposed regulations that inform citizens of proposals and request their considered input. Many such notices, such as planned levels of fishery harvest, or the proposed management scheme for the Florida Keys National Marine Sanctuary, are scheduled for public comment in the next few months.

(2) Regulations that, if not implemented, will have a measurable and substantial negative impact on our natural resources. For example, harvest levels of managed fish stocks must be set under existing fishery management plans.

Second, the Subcommittee may be aware of an exciting new program which NOAA is implementing in cooperation with other Federal agencies, called Global Learning and Observations to Benefit the Environment, or GLOBE. This interagency, international science program is designed to: (1) enhance global environmental awareness; (2) increase the scientific understanding of the earth by working with a worldwide network of schools to collect environmental observations; and (3) through hands-on science, support improved standards for mathematics and science education.

This scientific observation program will assist NOAA requirements for data, and build on NOAA's science strength and environmental mission. GLOBE is well underway, with thousands of schools across the country having stated their interest in becoming GLOBE schools in as early as April 1995. Over 100 countries have expressed an interest in GLOBE, and the United Nations has passed a resolution supporting the program.

SUMMARY

Throughout its history, NOAA's role has been to warn of danger and protect life and property, predict environmental changes in time and space, provide decisionmakers with reliable scientific information, and foster global environmental stewardship. As we look to the year 2005, we strongly believe that this mission, and our vision, will remain intact. Our research and services provide in equal measure for this future. No other agency working in the natural environment has NOAA's responsibility for the long-term measurement, monitoring and understanding of our atmospheric and marine systems. This information is increasingly critical in protecting the health, life and property of our citizens and in developing a new sustainable relationship with our environment and its resources.

Senator BURNS. Thank you, Dr. Baker. I would say that farmers listen to weather as much as they do markets. We in Montana are a captive shipper when it comes to transportation. Burlington Northern Railroad gets blamed for everything up there. And I tell the old story about the farmer that went through the perfect season, the spring opened up just right, the crop went in, the seeding was right, he got the rains at the right time, probably the most fantastic crop he had ever had. And when they drug out the combines and they were 2 days from starting to harvest, why, a hail storm came down through and just wiped him out. As you walked out across stubble about this high, he walked out across that field with a tear in his eye, and he says damn that Burlington Northern Railroad, anyway. [Laughter.]

I tell that story because weather, to agriculture, we watch it a lot. And that is why I am concerned about the new system, the modernization that is going on, and its capability, and I want to ask you that just for a little bit. Is it on target, and is it within budget, and is it doing what you think it would do, is it going to improve us?

Dr. BAKER. Well, let me take each one of those in turn. Yes, this program is on target. Yes, we are within an agreed budget. And we believe that we will not only not degrade the weather service, but in fact have a greatly improved weather service. By 1999, we will have all of the parts of the system in place, but it is an incremental arrangement.

We have in 1996 the radars will all be in place, by 1997 the automated surface observing systems, our satellites are flying and doing very well, in fact exceeding expectations, and then by 1999 we expect to have the full deployment of the new weather interactive processing system. But we are doing that also in incremental stages so that we can understand and make sure that we do it right.

Senator BURNS. If we go through this budget strain and your budget remains level, what effect does that have on you?

Dr. BAKER. Well, this has a huge effect on us, because as we put into place new technology we have to pay for it. And satellites cost money. Between the satellites and the Weather Service you have about $1.2 billion of a $2 billion total budget in NOAA, and we have an out-year projected cost which involves increased costs as we put in new capability satellites. And so it is very important that we all agree on what the costs are and we understand the impacts of those out- year costs.

Without an increase in budget, we cannot apply the new technology. But as I say, we have a budget which has been laid out. I think we have agreement on what that budget has to be. With budget cuts, of course, we could not deliver what we say we have agreed to deliver.

Senator BURNS. We have to go home and justify budgets to our constituents, and, Dr. Prabhakar, in ATP, I think probably if there was anything that was really noticed, it is the growth of expenditures in that program. Even from 1994 to 1995 it more than doubled. And I know it is a long-term thing you cannot put your finger on, these are tangible results, or can you?

Dr. PRABHAKAR. Well, let me try to answer that question. You are absolutely right, first of all, that today you cannot see all the full-blown economic effects from this very early stage investment.

But there are some things that we can put our finger on today that are quite concrete that come out of the examples of the activities that are underway. We have got a total of 177 activities, projects, individual projects within ATP. Half of those began just last fall, so again, it is a very early program. But from our very first examples, we have some stories today that tell us that we are on the right track.

They are stories like the one that Secretary Brown told you about Accuwave, small companies, and I think that is a typical story, where they began with a concept, and because ATP helped them get over the early technical barrier, they now have a pathway looking forward that is a real business pathway, something that they can pursue with their dollars with other private investment. And I think that is a dramatic change in opportunity that ATP is helping to provide.

If I could give you one very different example from another part of the spectrum, we have had a project underway called the 2-millimeter program; This is an activity that brings together a group of small automotive manufacturing suppliers along with the University of Michigan and two of the major auto manufacturers, Chrysler and GM. This is a team that has come together to try to improve the quality of the final assembly process for putting cars together. It turns out that that is a critical determinant of consumer satisfaction. It is a place where our competition has been doing better than our American companies have been doing, and what this team has been able to do is provide the process capability, but also the enabling tools from these smaller manufacturing firms, so that today we have not just the capability to manufacture with much greater assembly quality, but in fact we have got a process that is scalable, that is expandable. That is what ATP helped demonstrate, and now that manufacturing technology is being implemented, again on private dollars, by the manufacturers on their factory floors.

It is important, in that case, for the small manufacturers that are providing the tools that work on the factory floor, it is important to the auto manufacturers in their bid for global market share, and I think it is an interesting example of how the many players, the small companies and universities and the large companies, all need to link together to make some of these capability changes happen.

We have lots of those kinds of examples. We also have aggregate studies in ATP that demonstrate that we are helping to create new technologies that just would not be here any other way, that because of that companies are identifying new market opportunities, building new strategic relationships, exactly the kind of indicators today that tell you that you will see the full-blown economic effects tomorrow.

Senator BURNS. Senator Rockefeller.

Senator ROCKEFELLER. Thank you, Mr. Chairman. I have got a bunch of questions. Dr. Good, as you indicated you worked for industry, and you kind of buried that. You talked about being an academic for 20 years and industry for 13. I am interested in the industry for 13. You worked for a small mom and pop store called Allied Signal. Now, you have real experience, therefore. In other words, this is not theoretical, it is real. During that time, did you have any experience with the ATP program when you were at Allied Signal, No. 1? If so, why, if you applied, did you apply to ATP? What was the decision made? You were in charge of industrial research, as I understand it, and what was it that ATP enabled you to do that you would not have been able to do on your own, in that Allied Signal is not small?

Dr. GOOD. Thank you, Senator Rockefeller. Let me answer that in the following way: You are absolutely correct, and I did have some experience with the early days of ATP when I was in the industry. The decisions that are made as to how one goes about utilizing your own funds and what availability of funds there are from the Federal Government is kind of a unique one. And this business that says that industries just go out to get government, to get government money turns out not to be true. And the reason it is not true is you cannot afford to put your best people on things you do not need or want. It really is that simple. You can go back and argue whether you do or you do not.

We did have government programs that were part of the mission orientation. Our aerospace industry had a number of programs that were part of the defense programs, and those were designed to fit the defense needs, and they were helpful to us, and clearly, they were helpful to Defense or they would not have funded them. The ATP program, though, was the only program that the Federal Government had which allowed us to think about a program that might really change the way we played some of our games, and which let us drive it rather than having the Government tell us how to do it. And I have been very careful not to be involved in the Allied Signal one since I have been in this position, but the one that we put on the table to try to get from ATP early on was a very interesting one. Let me tell you about it, and I think you will understand.

Allied Signal has developed and has on the market what to me is the first truly new material in 20 years, and that is its rapidly solidified magnetic material that goes into storage transformers that gives you a major improvement in storage capacity and energy efficiency in power transformers. It is a very difficult technology. The manufacturing of it is very tough. We finally spent a lot of money, about $100 million, trying to get that technology to market; managed to, finally, with a joint partnership with General Electric who makes the transformers. We could make very thin metal because that is the only way we could get it with enough flexibility to make these transformers.

We were out there making that, we spent a lot of money, and we were spending all of our R&D money on that project on how to get the manufacturing up, how to get the costs out, how to understand what was required to do that, but we knew that if we really understood the magnetic properties of the thicker material and if we could understand the fundamental physics of the flow of thicker material, if we could have gotten thicker material with the same flexible properties, we could change the entire way that game is played, because you could put it not only in transformers but you could then put it in motors, you could do all sorts of things.

We did not have the time and the people to do the fundamental work that would have to be done to move into that arena. So we made an application for an ATP program to do that, and it included not us, and this is not just us, and one of the other problems we have is that that program, if you just look it up in the book, says it is an Allied Signal program, and it is, but it also had with it significant physicists at Syracuse and some other places to help do this fundamental work that we neither had the people nor the time to do. So what we picked was a program which really would change the rules of the game.

Now, I have been very scrupulous not to go back and ask. I do not know how well they have succeeded, because it really is a conflict of interest for me to do that. But the point was we picked a program that was an opportunity we did not have anywhere else.

The other issue was that we knew that it would get peer review, and if I could go to my CEO and say look, this thing has gone through the peer review, other folks think that it has some real reason for success, and I make my own arguments, and I can get 50 cents on the dollar to do the fundamental part of the research, you will still have to put up the $10 for every one to do the development, you get a better hearing from the CEO, as well, to do that kind of a really change the state-of-the-art process. So it provides an opportunity that no other program does.

Senator ROCKEFELLER. What if you had to rely on a tax cut?

Dr. GOOD. The tax cut, if that has been the case, I would have put more money in doing the manufacturing on a product I was already trying to get out the door. I would try to get another 50 cents per pound out of the cost, because that is what made me competitive. It would have to improve a product I had.

Senator ROCKEFELLER. Let us go for the jugular on this thing. A fair question to ask is what does industry itself say is most useful? The Industrial Research Institute, which is a major industry group, conducted a survey of industry research executives to see which Federal programs they found the most useful. Am I correct in saying that this industry survey ranked the ATP as the Federal program in research most useful to their industry?

Dr. GOOD. That is correct. The IRI is a group that represents all of the industries that contribute about 80 to 90 percent of all the research done in the United States, so it is really a very significant group. And when they went out to survey their people, if you remembered my chart that had all of the various kinds of programs that we try to do to pull the industry and the Government programs together, they ranked ATP first in that survey.

Senator ROCKEFELLER. This has to do with bipartisanship. You worked under the Reagan administration, you worked under the Bush administration, you are working under the Clinton administration. The Bush administration actively supported—in fact, it founded—the concept of precommercial technologies, especially ones based upon federally funded basic research. President Bush, in March 1991 said this in an address to the American Electronics Association. We are dealing now with a different dynamic politically in Washington, and you have this specter of an ideological fervor which is not necessarily based upon fact, but which necessarily carries the day because the facts are unknown. Is it just not unequivocally true that this concept of ATP—advanced technology programs and the manufacturing extension programs with the centers in many different places—is a classic full-throated absolute example of bipartisan cooperation in their genesis and in their carrying out so far?

Dr. GOOD. Senator, to the best of my knowledge that is absolutely correct, and PCAST worked very hard during the Bush administration to back this experiment with ATP. We were very pleased when it finally got funded. We were not very happy that it got funded at $10 million to start. We thought it should have had a much more healthy beginning than that. On the other hand, that $10 million started the experiment and let people learn how do it properly, so in some ways perhaps that was not such a wrong thing to do.

But there is no question that all of these programs in the past, and in fact one of the reasons that I was enthusiastic about taking this particular position was that I felt that we had some momentum going to get these kinds of things done, that we had started that in the 4 years in front of this, and that we now had some real bipartisan understanding of it. Both sides of the House, we thought, were in favor of it, and we thought it had a lot of momentum and we could really make some differences with these.

My own view is that these programs, if we do not do whatever is required to incentivize the American industry to do research and development in the United States and to rapidly convert the research base we have to products, we will not survive in today's world. And all you have to do is go visit a couple of places to figure that out.

Senator ROCKEFELLER. You just came back from Japan. Are they relaxing on their competitive policies?

Dr. GOOD. No, sir, they are not. And in fact, we spent a lot of time in Japan talking to our industry representatives there, as well as the Japanese. And there are a lot of folks who think that the Japanese have had a hiccup, and I guess they have, with the recession and some of the other problems. But anyone who suggests that they are out of the game simply does not understand. They are actively pushing their own programs. They have not backed down.

One of the things that they are concerned about, they are concerned that we are learning to play the game correctly. And I agree with the Secretary this morning on the question that you raised, as well, that my view of talking to them is that they, No. 1, cannot imagine that we would back off from what we are doing; and second, they are silently clapping their hands hoping we will.

Senator ROCKEFELLER. Mr. Chairman, my time is up.

Senator BURNS. Thank you, Senator Rockefeller. Let us follow up on that just a little bit, because I just have a couple of more questions, and I want to see what the effects would be. What would be the effect in budgetary, and say we are talking about 1996 budget coming up now, if that budget just remained level, just hold the dollars that we are now spending in the ATP program now?

Dr. GOOD. If we just stayed where we are now, clearly that is better than eliminating it, which is what we have heard from some folks.

Senator BURNS. That was going to be my next question.

Dr. GOOD. Mr. Chairman, the issue here is that we need to look at these programs and which ones are doing the best kinds of things. I am absolutely convinced that ATP is doing a better job of moving our tech base, which we already have paid or money for, and getting that moving into the industry than anything else we are doing. And therefore, if I were to keep any budget level it would not be ATP.

Senator BURNS. Dr. Prabhakar, do you agree with that?

Dr. PRABHAKAR. I would absolutely agree with that. Let me see if I can also give you some specifics. The budget that we have been planning for is one that the President laid in place as a plan when this administration began, and it is a ramp-up designed to get ATP to the point that it can be a full-scale national program. You have commented about the size of the program, and you are absolutely right that the growth rate has been dramatic.

But I would like to comment, as well, that I came to this job from a job as a civil servant in another agency in the Federal R&D portfolio, and that is the Advanced Research Projects Agency in the Defense Department. The budget there is approximately $2.6 billion today, and even that is a small fraction of what we spend in our total R&D portfolio. So I do not find the overall dollars in ATP to be terribly dramatic in that scale.

In terms of the effect of a flat budget in ATP, because we have been planning for a ramp-up, we have had a very active engagement with industry from virtually every sector of the technology arena. They have been coming forward with program ideas, with project ideas. The goal has been to ramp those up. We would not be able to continue the work that we have started in the efforts where industry has come forward, where we have been running planning workshops, and I think that would be a lost opportunity.

But again, I think the fundamental issue is that the signal we send by slowing these programs is a signal that says gee, maybe we do not think these partnerships are as important. I think it is critical that we not back away from what is still a new, but I think a very critical, element of our overall investment strategy.

Dr. GOOD. Can I make one last comment? First of all, at the same time I also agree that ATP should not grow forever. That is also an important point. I do not argue that it should be $5 billion. But it does need to be big enough to be a national program, and what we think is the $750 million for 1997 gets you close to that. Because remember, you have got another 50 percent coming in from the industry, so you are talking about a billion and a half dollar program, and that now can be a national program. I do not believe it ought to be 20 percent of the R&D budget, but I think for it to be something like about 2 percent of the R&D budget to do this kind of thing makes an awful lot of sense.

The other issue we have, if we slow down—and with that $750 million we can do about 20 of these focus programs. And that means each year you will finish one and you will have new ones, and you will keep the stimulation of the industry going. That is what the whole thing is all about.

We have two issues: If we slow down or stop at this moment, the industry will never come back to cooperate with the Government. We have promised these people that this is a cooperative program with partnerships. They have put a lot more time and money into it than the Government has. They bring their people, they put a lot of time of planning into it, they bring lots of people to the table. A lot of people who never even apply get a lot out of this program because they come and interact with the groups who decide what to do. And if we do not stay with this program, they will say you are an unreliable partner, and they will not return. It will be a disaster for the country overall.

So I think we have to really look and prioritize these things and understand which ones really deliver and which ones do not and make some real decisions to do that.

Senator BURNS. I want to thank you. I have no more questions for this panel. Senator Rockefeller has a couple. I would recognize you at this time.

Senator ROCKEFELLER. Thank you, Mr. Chairman. These are for Dr. Prabhakar. This is the "winners and losers" issue. You have not spoken on it, and I just want to drive this thing home as far as I can: Nobody criticizes ATP for being badly run. In fact, it is universally praised as being well run, money not wasted. What they do criticize it for is the question of picking winners and losers, which if you say that in this country today is countercultural. I would like you to comment on the business of whether or not it is bypassing the market system and whether we are picking winners and losers.

Dr. PRABHAKAR. Thanks for the opportunity to address that. And I would start by remembering Secretary Brown's comment that those who are making these charges ought to come and take a good, hard look at how we are actually running the program.

I would ask you to consider for a moment, Senator Rockefeller, what it actually takes for a company to make a technology winner in the marketplace. Beyond the very early stage, risk-reduction activities that ATP helps share the cost for, a company has to invest very significantly in product development, in manufacturing and production, in marketing, in sales and distribution. A company's ability to do all of those jobs well is what really, in the end, determines winners and losers in the marketplace, as is appropriate.

I think we really trivialize what companies need to do to make winners in the marketplace if we pretend that early stage risk reduction in a program like ATP is in any way a substitute for those very significant investments that have to come downstream.

Senator ROCKEFELLER. One other question: ATP's staff, in fact, is small. How many is it?

Dr. PRABHAKAR. I think we are at a about a total of 50 right now, and our plan is to ramp to a total of no more than 100 for a $750 million program.

Senator ROCKEFELLER. I would like to get a sense from you of who these people are. In other words, I think people have no idea how they are picked, what their skills are, what qualities they might have. Could you tell me?

Dr. PRABHAKAR. Absolutely, because, in fact, having good, smart people is essential for any of these programs. Let me just give you some examples of recent hires that we have made in the Advanced Technology Program. We have a new program manager who came to us from Digital Equipment Corporation where he was a vice president, where he managed businesses for DEC, where he was involved with new information network technology. His previous experience included IBM, and before that, I believe, Bell Labs, a very substantial individual who brings a tremendous knowledge of technology trends, industry interactions, and he has been able very rapidly to mobilize a program working with the industry.

We have a staff member, a program manager in the software area, who had previously been involved in a soft software startup of his own from a university spinoff.

We have a chemical engineer on our program management staff, a woman who worked previously for Shell Oil and managed programs in the Department of Energy, and got a very broad perspective on activities before she joined the ATP staff.

On our business and economics staff, that are also an essential part of running our ATP activities and evaluating what comes out of those programs, we have one hire in the last year, a young man who has a Ph.D. in physics from I believe the University of California at Santa Barbara and an MBA from Wharton. And I think we often, in that part of our activities, are getting tremendous capabilities, people who have a strong technical background coupled with business degrees coupled with consulting experiences with small companies, and again, that understanding of the link between technology and business that is so vital for our program.

Senator ROCKEFELLER. Final question, and again, Mr. Chairman, I thank you for your forbearance. The manufacturing extension program, to me, is life and death for the little communities in West Virginia and other places that, through the manufacturing extension centers, have a mechanism that allows technology to flow to companies that could not otherwise know it was even there. Often in Washington, when people are not sure about something or do not think they like something or are quite certain they do not like something, they do not want to see it happen, they say, well, that is just a big new Federal bureaucracy. Is the Manufacturing Extension Partnership a big new Federal bureaucracy?

Dr. PRABHAKAR. Well, I have thought it over, and the answer to that question is no. In fact, in that program, like in ATP, of the resources that are appropriated to NIST, almost every one of those dollars is going out into the community. In the case of manufacturing extension, it is typically going to not-for-profit organizations that we cofund with State and local governments. So again, there, our staff is extremely small. I think in that program we are at about 30 FTE's, the Federal employees, again because our goal is not just to perpetuate the bureaucracy in Gaithersburg, our job is to have the small staff that can provide value added to the activities out in the community, in the States and the local communities where they can really touch small manufacturers.

Senator ROCKEFELLER. So that ATP, the Advanced Technology Program, the Manufacturing Extension Program, in terms of full-time equivalent Government employees, comes to a grand total of 80?

Dr. PRABHAKAR. I would like to confirm those numbers for the record, but that is a very good estimate.

Senator ROCKEFELLER. Thank you, Mr. Chairman.

Senator BURNS. Dr. Baker, another comment?

Dr. BAKER. Could I just say a word in support of ATP? [Laughter.]

It is my responsibility, as the head of NOAA, to look to the future and make sure that we can deliver the services that we need for weather forecasting and other environmental observations. Today, the technology that we use is heavily dependent on microcircuitry, which is in turn dependent on the invention of the transistor. That satellite there, the new terminals that we have, all of the systems, depend on having this solid state electronics.

The development in solid state electronics that led to microcircuitry was done in Bell Labs by AT&T at a time when they had a monopoly and they could afford to do that kind of basic research, and it was not clear where it was going to lead. Today, as companies become necessarily globally competitive, they have to cut out that part of the new things which they are doing, and that is precisely what we depend on for the next generation of delivering information out to people.

So we are heavily dependent on a program like this that allows companies to do this thing, to develop the technologies which we will eventually use for the next generation of services.

Senator BURNS. Thank you very much. We want to thank all three of you for coming today. I think it is incumbent on all of us who believe in these programs and know of its importance because we see the impact that it has, and if we as policymakers do not live up to our responsibility in taking care of our grandchildren, that is the generation that we are talking about now, then I think we have been very remiss as far as our duties are concerned here in the U.S. Senate.

I thank Senator Rockefeller and you this morning. Thank you for coming. The record will be open, and your statements will be made a part of that record, and I thank you very much, and these hearings are closed.

[Whereupon, at 12:30 p.m., the hearing was adjourned.]

APPENDIX

QUESTIONS ASKED BY SENATOR PRESSLER AND ANSWERS THERETO BY SECRETARY BROWN (INCLUDES DR. BAKER'S, DR. GOOD'S, AND DR. PRABHAKAR'S QUESTIONS AND RESPONSES)

Technology/NIST

QUESTION 1A. During the last year's debate on the National Competitiveness Act, the NIST technology grant program (the Advanced Technology Program) was criticized as an example of industrial policy, that is, picking winners and losers. However, some believe the grant programs provide critical early-stage seed money for technology development efforts. Secretary Brown, how would you characterize the NIST programs in the context of that debate?

Answer 1A. The Advanced Technology Program (ATP) is indeed early-stage seed money for technology development rather than industrial policy. It focuses on a need of U.S. industry that is not addressed by other programs and that would not otherwise be addressed by industry. The sole aim of the ATP is to stimulate the development of high-risk, high-payoff enabling technologies by industry that it would otherwise not pursue because of technical risks or other obstacles.

The ATP is not picking winners and losers. The ATP projects reflect industry's priorities and the private sector's understanding of opportunities. While government acts as the catalyst, industry conceives, co-funds, and executes each ATP project. Furthermore, winners in the marketplace are produced by industry's efforts in developing products, manufacturing, marketing, distribution, and service. All of these jobs belong to industry and ATP is doing none of them. The ATP's job is to share the cost of reducing the high risks at the pre-product development stage.

The ATP provides indispensable "seed money" for a specific class of technology development—risky, potentially high payoff, enabling technologies—and also stimulates industry to consider new opportunities for the country's technology base. It works for companies of all sizes: both small start-up companies and large established firms face obstacles in performing the kind of R&D that the ATP promotes. About half of the ATP awards have gone to projects championed by small businesses.

QUESTION 1B. In your view, what are the strengths and weaknesses of federal technology grant programs?

Answer 1B. The strength or weakness of federal grants programs should be judged against these criteria:

- *Appropriate government role. Government programs should not replace private investment. The ATP's focus on pre-product development of enabling technologies is an appropriate government role.*
- *Customer driven. U.S. industry drives the priorities for the ATP's investments.*
- *Competitive. Awards should be made on the basis of rigorous competitive processes. All ATP projects are selected through fair and rigorous competitions that draws on both government and private sector expert reviewers.*
- *Evaluation. To ensure that taxpayers are receiving the greatest possible return on their investment, the ATP has built in performance measures to track short-term results and long-term economic impacts of the program.*

QUESTION 2. Many argue that any successful competitiveness strategy must include antitrust reform, product liability, appropriate deregulation, tax incentives, and vigorous enforcement of existing trade agreements. What role does each of these various elements play in Clinton Administration's technology policy?

Answer 2. The Clinton Administration is pursuing a four-part competitiveness strategy emphasizing skills and training, increasing our rate of private investment, opening world markets, and promoting technological innovation. All of the issues raised in your questions are vital parts of our competitiveness strategy.

Our strategy recognizes that there is no "one size fits all" formula for ensuring that our companies lead the world in innovation. We are addressing the broad range of factors that affect our companies' ability to develop technology, turn innovations into products and services, and bring them to global markets. These issues include capital availability, strengthening intellectual property protection, reforming regulatory barriers to innovation, and reducing Cold War export controls.

Each of the four pillars of our competitiveness strategy—skills, investment, trade, and innovation—are important to our nation's long-term economic growth, and each cannot serve as substitutes for another. For example, the business environment and trade elements listed in your question deal with different problems from those addressed by the technology infrastructure initiatives of the Department and the Ad-

ministration. In particular, tax incentives are not an effective substitute for the ATP because they do not address the barriers to high-risk research and development of enabling technologies.

QUESTION 3A. Funding for the Advanced Technology Program (ATP) has increased from $10 million in FY90 to $431 million in FY95. The FY95 funding level is more than double the FY94 level. Is it fair to suggest that maybe this program has grown too big, too fast?

Answer 3A. From its inception, the ATP was conceived as a national program that could expand. This Administration has indicated that its plan includes $750 million for ATP by FY 1997, and it was designed accordingly. Therefore, the ATP's expansion has been built on a solid foundation. Indicative of its efficient operation, the ATP has grown from $10M to $431M in five years while keeping its administrative costs below 3% of its budget. ATP has an experienced staff and a well-established, fair and rigorous procedure for processing and evaluating hundreds of proposals under short turnaround times. The ATP has a current pool of over 1500 technical reviewers and over 250 private-sector business reviewers from which to draw expert advice. The ATP also has a secure internal tracking system in place for protecting proprietary R&D and business plans contained in proposals submitted by industry to ATP's general and focused competitions. To date, the ATP has received and processed many more worthwhile proposals than it has been able to fund. The ATP has digested its rapid expansion and is fully capable of further growth.

QUESTION 3B. Before Congress agrees to any further expansion of the ATP, should we not determine whether the program is producing any breakthrough technologies or other tangible benefits?

Answer 3B. The strongest argument against slowing planned program growth is the overwhelming support for ATP among industrial leaders who are facing daily technology-based competition in the world marketplace. A flat budget would destroy the momentum created for a new type of industry-led industry, government, university partnership; a partnership with appropriate roles, appropriate, goals and exciting prospects for U.S. economic growth.

The goal of the ATP is to promote economic growth by working with industry to develop high-risk, potentially high-payoff, enabling technologies. Implicit in this goal is the understanding that the ultimate payoff—economic growth—will follow the introduction of new products and processes after completion of the ATP-sponsored R&D. Since the ATP is a new program, most of its projects are still very much in the research or pre-product development phase. Nevertheless, several of the ATP projects are already producing breakthrough technologies and tangible benefits.

Although only 11 of the 177 ATP projects funded to date have been completed, a number of milestones associated with significant technology breakthroughs have been accomplished:

- *ion implantation technology enables significant productivity improvement in the U.S. semiconductor industry;*
- *technology to produce revolutionary true-green light-emitting diodes provides high capacity solutions in optical storage and communications, and applications in flat panel displays;*
- *special optical crystals for holographic data storage vastly increase the number of signals that can be transmitted in fiber optic communications; and*
- *prosthetic tissue woven like cloth to form biodegradable implants may serve as a matrix on which the body's own cells could grow to replace damaged tissues.*

Other tangible benefits of the ATP program are:

- *Promoting industry alliances. The ATP is encouraging industry to form cooperative R&D ventures for large projects. Alliances are forming among competitors, and among customers and suppliers. 61 of ATP's 177 awards have gone to joint ventures and most or all of these were formed specifically for the ATP project. In addition, there are myriad informal alliances and subcontractor arrangements in both single applicant and joint venture projects.*
- *Encouraging high-risk R&D. Case studies and third-party surveys show that the ATP is stimulating R&D projects that otherwise would not have been attempted, or would not have been pursued in the same market-critical time-frame or at the same level of effort.*
- *Increasing research efficiency and reducing time-to-market. These effects are documented in surveys and case studies.*

Attachment 1 on individual ATP projects further illustrate the impact the program is having.

Actual ex post measurement of long-term economic outcome is of course still premature, but the ATP has an evaluation plan in place for measuring short- to medium-term as well as long-term economic impact. ATP's evaluation plan has five elements:

- *evaluating ATP's operational procedures;*
- *profiling applicants, recipients, technologies and projects for portfolio management;*
- *evaluating company implementation of R&D and business plans;*
- *tracking interim indicators of success; and*
- *measuring long-term economic impacts.*

TRACKING INTERIM INDICATORS OF SUCCESS PROVIDES A SIGNAL OF THE POTENTIAL OF ATP-FUNDED PROJECTS TO PRODUCE LONG-TERM BENEFITS

The ATP is aggressively pursuing evaluation of long-term economic impacts by:

- *establishing a solid information collection system;*
- *commissioning detailed microeconomic case studies;*
- *supporting the development and use of economic models for projecting outcomes;*
- *pursuing a variety of other approaches for measuring outcomes of R&D projects; and*
- *involving outside leading experts in reviewing our methodologies to ensure state-of-the-art evaluation.*

To summarize, the ATP is now producing tangible benefits, including technical breakthroughs on a faster track to market, with great potential for economic impact. There is substantial evidence that the ATP is well-equipped and well-motivated, with experience, planning, and evaluation mechanisms in place, to manage the expansion of the program. Growth of the program will enable the ATP to become a truly national program, bringing new technologies into the pipeline to benefit the U.S. economy.

QUESTION 4A. It is my understanding that the Clinton Administration plans to increase its Manufacturing Technology Centers and smaller technical assistance centers from 44 to 100 by 1997. How effective has that NIST program been?

Answer 4A. The centers served nearly 9000 manufacturers during the first three quarters of 1994. They are helping smaller manufacturers through hands-on assessments and advice, technology demonstrations, training, and seminars on specific manufacturing and business issues.

Surveys of our client firms show significant improvements in manufacturing and business performance, with benefits greatly exceeding the federal investment in MEP. For example, 395 companies returning surveys to the original seven centers reported an economic impact of more than $82 million for technical assistance provided by MEP; a 7 to 1 return on the federal investment. The impacts include changes in sales, capital spending and capital avoidance, inventory reductions, labor and material savings, and jobs created or saved.

Through the MEP, smaller manufacturers have greatly increased access to a national network of supporting services provided by state and local extension centers. These centers extend their reach and broaden the range of service available to these small companies. Moreover, private consultants working with the Centers are finding that they have much better access to smaller manufacturers as clients.

QUESTION 4B. Can you share with us any "success stories" that it has produced so far?

Answer 4B.

- *Clipper Diamond Tool Co. Inc., Long Island City, N.Y., was losing customers to Japan and Europe and badly needed modernization. The NIST Manufacturing Extension Center in New York City helped the company get the advice it needed to relocate within the city and to automate its manufacturing and office operations. "Our company has been revitalized," says President Joseph Klipper. "We are once again able to compete both here in the United States and around the world."*
- *Under its new management, Thomson Berry Farms, Duluth, Minn., was looking for a makeover. The NIST extension center affiliate in Virginia, Minn., helped the company hire an engineering consultant who redesigned the firm's plant layout and suggested other changes that turned the company—in one year—into a profitable enterprise. "Our changes allowed us to cut our labor costs in half," without eliminating any jobs, says CEO Paul Leonidas. "They also helped us go out and seek more business. We have almost quadrupled the production capabilities of the plant."*
- *Accuspray Inc., Cleveland, Ohio, manufactures commercial and industrial paint spraying equipment. When the company needed help refining a paint sprayer design, it turned to the NIST extension center in Cleveland. The center put the company in touch with university researchers who helped make the sprayer 50 percent more efficient. The center also recommended changes in plant layout that saved $500,000 in construction costs and shortened lead times for manufacturing the sprayers from 10 days to two.*

QUESTION 4C. Where will you find the money to support such a dramatic expansion of the program?

Answer 4C. The MEP has established 44 manufacturing centers in 32 states, through its own funding and through larger resources available from the Technology Reinvestment Project. The FY96 budget request for the MEP includes an increase to be used to run competitions for 10 additional extension centers and to take over the federal government's share of funding for 22 centers originally supported by the TRP.

QUESTION 5. Although there are 44 Manufacturing Technology Centers and smaller centers throughout the U.S., South Dakota and other rural states are not serviced by any of those centers. What efforts is DOC making to reach out to small- and medium-sized plants outside the centers' coverage area?

Answer 5. Our regional manager for the South Dakota area, Kevin McIntyre, is currently working with Mr. Tom Arneson of the South Dakota School of Mines and Technology. The South Dakota contingent tried for a TRP award in 1993 and they applied for a STEP grant in 1994. Unfortunately, neither proposal was selected for funding. On January 12, 1995, Mr. Arneson attended the Central Center Directors meeting in St. Louis and received input and assistance on their proposal from manufacturing centers in the network. South Dakota plans to submit a proposal for the NIST MEP solicitation in Summer 1995.

Many rural states are already funded under the NIST MEP. North Dakota was awarded funding to utilize field agents and resources at the North Dakota University to assist defense-dependent companies develop new markets and alternative products. Kansas is another example of a rural state utilizing the NIST MEP to extend services to smaller manufacturers throughout Mid-America. Kansas has been so successful that they have worked with Missouri, Colorado and Wyoming to provide services to manufacturers in those states as well. In fact, MEP has a wealth of success stories in rural states across America.

Assistance to states that need to organize to produce a winning proposal for MEP funding is provided by the Regional Manager for individual states. Each state is targeted based on its manufacturing population and the Regional Manager provides assistance throughout the solicitation process from beginning to end.

In addition, the State Technology Extension Program was set up to work with States to develop industrial extension programs and the modernization infrastructure to serve the needs of smaller manufacturers. STEP assistance focuses on helping states improve planning, coordination, and initial implementation of technological extension activities. This program benefits rural states that may not yet have the infrastructure in place to support a manufacturing extension center. In addition, it provides some federal financial support to rural states who may not otherwise be able to undertake the extensive planning and coordination needed to achieve an organized system.

Weather Service Privatization

QUESTION 6A. Are there certain activities within NOAA, particularly in the Weather Service, that can be transferred to the private sector?

Answer 6A. The agricultural, fruit frost, fire weather (except that the National Weather Service (NWS) will continue Federal and wildfire support activities) and marine radiofacsimile programs have been identified in the President's FY 1996 Budget as services that could be performed by the private sector.

NWS is provided $1,676,000 for agriculture weather services, including observations, advisories, forecasts, and warnings. A total of $640,000 is provided for fruit-frost warnings for winter and spring crops, particularly in citrus and deciduous fruit-growing areas. These agricultural weather services were previously mandated by Congress, and NWS works closely with the Department of Agriculture and the states to provide these services.

NWS provides $449,000 for specialized forestry management services to non-Federal users, including advisories for controlled burning, pest management, and reforestation on non-Federal lands. Users of these specialized services should purchase site-specific information directly from the private sector. NWS will continue to provide support for large dangerous wildfires and for Federal forestry management activities such as controlled burning, pest management, and reforestation.

NWS will eliminate the dissemination of weather charts ($500,000) via marine radiofacsimile broadcasts used by the maritime community.

The NWS will continue to provide basic warning, forecast, and advisory services to users in all of these affected areas.

QUESTION 6B. Does DOC or NOAA have any plans to systematically identify programs or activities that can be effectively "privatized"?

Answer 6B. NWS has historically worked with the Congress and the private sector to systematically identify elements for privatization. In the early 1980's, the Adminis-

tration and the Congress agreed that the Federal role of the NWS should focus on operating the necessary ground and satellite systems infrastructure and providing basic weather and flood forecast and warnings for the protection of life and property for the "public good." The private sector would focus on the specific tailoring of NWS data and information for individual users. This opportunity has given rise to a value-added industry now estimated to be over $219 million. Specifically, the private sector is now responsible for:

- *Tailored weather, river, and water resources forecasts and detailed hydrometeorological information, consultation, and data for weather, river, and water resources-sensitive industries and private organizations;*
- *Value-added products such as weather and hydrologic-related computer hardware and software, observational systems, imaging systems, displays, communications, charts, graphs, maps, and images for clients; and*
- *Climatological summaries, probability values of weather extremes, and similar material for specific design and construction problems.*

NWS has worked cooperatively with the private sector to establish procedures (NWS Operations Manual, Chapter A-06) to periodically review, update, and redefine the role of the NWS. There is a mechanism in place to resolve any conflict over the roles of the NWS or private sector when new NWS services or products are developed. Examples of services that the NWS has turned over to the private sector during the past 10 years include: national radar summaries, newspaper daily weather maps, weather telephone information services, and direct radio broadcasts.

QUESTION 6C. What factors should be considered in determining whether a particular NOAA function should be "privatized"?

Answer 6C. NOAA evaluates existing programs in a manner consistent with OMB Circular A-76, in order to determine the appropriateness of privatizing existing government functions. We rely upon commercial sources to supply needed products and services, where appropriate. We are dedicated to providing to the Nation efficient and productive service of inherently Governmental functions. We continue to evaluate the nature of our programs to identify elements for privatization as evidenced by the those recently identified in the President's FY 1996 Budget.

Weather Service Modernization

QUESTION 7. As one of the sponsors of Weather Service Modernization Act of 1992, I am keenly concerned that the modernization effort stay on schedule. However, I am equally concerned that weather services not be degraded in the transition from the old system to the new system. What is the status of the modernization effort in general, and in South Dakota, in particular?

Answer 7. The National Weather Service (NWS) is near the mid-point of its massive modernization and associated restructuring (MAR) to dramatically improve the quality and reliability of its products and services. Advances in meteorology and hydrology, as well as in the technology for observing and analyzing the atmosphere, are already providing unprecedented improvements in weather services.

With the rapid advancement of technology, the NWS has the ability to collect and process large amounts of atmospheric data over greater areas and at higher rates. This ability provides the potential for more accurate, timely, and site-specific forecasts and warnings.

The status of each major modernization program is listed below:

NEXRAD. As the cornerstone of the NWS modernization, the advanced NEXRAD Doppler radar replaces the current obsolete weather radars by providing data for more timely and accurate weather and flood warning and forecasts. The triagency radar program is currently in the final stages of full-scale deployment. Since the NEXRAD contract was renegotiated in fiscal year 1992, the program has met all major schedule milestones. By the end of fiscal year 1995, 133 out of the total 163 triagency systems will be deployed. The remaining radars will be delivered in fiscal year 1996. During fiscal year 1995, final hardware and logistics acquisition portions of the program will be completed. Beginning in fiscal year 1995, the program emphasis will shift to operational support and system improvement efforts. In terms of performance, the radars have received very positive feedback from both the weather community and the public.

ASOS. ASOS is a key element of the NWS modernization and also supports the FAA and DOD modernizations by automating their respective surface weather observation programs. ASOS automates and significantly enhances the current, largely manual, methods for collecting, processing, displaying, and storing surface weather observations. The program presently is in the full scale deployment phase. By the end of fiscal year 1995, 628 out of a total 868 ASOS units will be installed at sites around the country. Final ASOS units will be installed in fiscal years 1996–1997.

In fiscal year 1996, the program emphasis will shift to system improvement and operational support issues. (See question 8 regarding ASOS commissioning.)

AWIPS. AWIPS is the heart of future operations for weather offices across the country. It will integrate satellite and radar data for the first time and provide the local weather offices with an advanced forecasting system. In FY 1994, significant problems surfaced between the Government and the prime contractor, PRC, Inc. A team of experts completed an extensive independent assessment of all AWIPS development and acquisition activities. Recommendations resulted in a restructuring of the program. We are currently completing AWIPS System Design with a target completion date of April 1995 and expect to begin renegotiation with the prime contractor, PRC, shortly. An early prototype of AWIPS, called Pathfinder, is under development and will be delivered to NWS Headquarters and three field sites by PRC in late spring. Development activities will continue through fiscal year 1996 with nationwide deployment in fiscal year 1997.

STAFFING. (MARDI) Plans for staffing new WFOs are proceeding according to plan. By the end of fiscal year 1995, 98 out of total of 118 new weather offices will be staffed to operate new NEXRAD radars (Stage 1). Staffing necessary to operate the AWIPS workstations (Stage II) will begin in FY 1996.

WFO CONSTRUCTION. The WFO construction program is proceeding according to plan. By the end of fiscal year 1995, 108 WFOs out of a total 118 will have been either built or leased. The final 10 forecast offices are scheduled for completion during fiscal years 1996–1997. The program emphasis in fiscal year 1996 will shift to completing the remaining construction activities and focusing on maintenance issues for the new offices.

GOES. The most recent Geostational Operational Environmental Satellite (GOES) was launched successfully in April 1994. Preliminary data began flowing late summer. The satellite is not yet commissioned; it is being moved to its operational position of 75 degrees west latitude as of February 27. After a NOAA assessment, the satellite should be commissioned in the spring. GOES J (9) is scheduled for launch May 19, 1995.

CONTINUED SERVICES. With respect to no degradation of service, the NWS has contracted with the National Research Council for its assessment of radar coverage. In connection with this assessment, the NWS published a notice in the Federal Register on November 4, 1994, soliciting comments identifying "areas of concern." Since that time, the NWS has forwarded to the National Academy of Sciences for review comments from residents of 32 communities in the United States who expressed concerns about potential degradation of weather services under the MAR. The list of communities was published in the *Federal Register* on February 23, 1995. There were no areas of concern identified in South Dakota.

The notice requested comments identifying service areas where some communities believe that current weather services may be degraded as existing radars are decommissioned or as field offices are closed, consolidated, automated or related during the MAR. The NWS received more than 67,000 public comments during the 60-day period that closed on January 3, 1995.

The intent of the comment period was to allow citizens to comment on our modernization efforts. While the overwhelming response indicates that the NWS provides a service valued by the American public, the exercise demonstrated that there are communities around the country whose residents have concerns about modernization plans.

All public comments were forwarded to the National Academy of Sciences' National Research Council in Washington, D.C. The NRC is considering the comments during its study on the adequacy of Next Generation Weather Radar (NEXRAD) coverage and the effect of weather office consolidation proposed under the MAR.

An NRC report on the MAR is due to Secretary of Commerce Ronald H. Brown in May 1995. Secretary Brown will then report to Congress on adjustments needed to the modernization plan to ensure no degradation of weather services occurs in these areas. The Secretary's report to Congress is expected this fall.

Until this process is complete in the areas where residents expressed concern, no existing radars will be permanently shut down, and no existing offices will be consolidated.

South Dakota. Under the NWS modernization, South Dakota will have three modernized WFOs in Aberdeen, Sioux Falls, and Rapid City. Huron is the only office slated for eventual closure when the NWS can certify there is no degradation of services.

- *The Aberdeen office received its NEXRAD in September 1994 and has expanded to 24-hour daily operation. The WFO will have responsibility for 22 counties in northern and central South Dakota and 2 counties in west central Minnesota. The upper air observations program has been transferred from the Weather Service Office* *in Huron. The ASOS was installed at the Aberdeen Regional Airport in June 1993 and accepted in July 1993.*

- *The Sioux Falls office received its NEXRAD in October 1993. This WFO will be responsible for 11 counties in northwestern Iowa, 8 counties in southwestern Minnesota, and 18 counties in southeastern South Dakota. ASOS was installed and accepted in July 1993 at Foss Field.*
- *The Rapid City office is scheduled to receive its NEXRAD in September 1995. This WFO will be responsible for 16 counties in western South Dakota and 3 counties in northeastern Wyoming. ASOS was installed and accepted in September 1994 at Rapid City Regional Airport.*

QUESTION 8. I understand that NOAA has ceased further installations of its new automated surface observing system (ASOS) until technical problems in the new system can be fixed. What are the problems with the new system and when do you expect them to be resolved?

Answer 8. NOAA continues to accept ASOS systems for installation. However, commissioning of the systems is under a temporary pause to address three principal areas for NWS sites:

- *improving the availability of repair parts to adequately support both commissioned and soon-to-be-commissioned ASOSs;*
- *installing of improved wind systems to minimize failures during certain winter-related conditions; and*
- *upgrading the precipitation accumulation gauges for new.*

Testing has been successfully completed on the last two items, and plans are underway to implement them as soon as the ASOS contractor can deliver the improved sensors. Deliveries have begun and all candidate commission sites will receive modified sensors by the end of April.

There are two commissioning criteria for ASOS-related spare parts: (1) sufficient logistics pipeline spares at the NOAA Logistics Support Center (NLSC) to support commissioned sites, and (2) all ASOS repair technicians' spare kits at the 100 percent level. Procurement activities are underway to provide sufficient stocking levels to allow re-start of commissioning.

Commissioning of both the NWS and FAA-sponsored ASOSs collocated with FAA Air Traffic Control Towers is also dependent on providing weather observations from the ASOS to the controllers. FAA agreements with its union have placed restrictions on the NWS's ability to place ASOS receptor equipment in the towers and, thus, limit the number of NWS ASOSs that can be commissioned at this time.

Commissioning of FAA-sponsored ASOS also has been delayed because of other issues: the inability of FAA communications to successfully deliver observations to our monitoring center, and radio frequency interference problems with ground-to-air radios that communicate with pilots on approach to the airport. The FAA, with significant NWS involvement, is working to correct these problems and is making substantial progress. The FAA communications at selected FAA sites has attained recently the commissioning standards that NWS requires for reliability. NWS and FAA are prepared to begin commissioning FAA-sponsored ASOSs, on a limited scale, beginning in March.

Landsat

QUESTION 9. Both of the Landsat satellites have lasted almost a decade beyond their design lives; therefore, developing and launching a replacement (Landsat 7) as soon as possible is critical to avoiding a Landsat data gap. What is the status of the Landsat development and what is the current schedule for launching Landsat 7?

Answer 9. The status of the Landsat 7 development is shown in NOAA's FY 1996 President's Budget Request. NOAA requested an increase of $12 million to start funding its share of the Landsat 7 program. Funds are required in FY 1996 to begin procurement of the associated Landsat 7 ground system; an additional $12 million will be required in FY 1997 to complete this procurement. The ground system functions needed to accomplish the Landsat 7 mission include: command and control and scheduling of data acquisition; data capture to receive the acquired data; data processing to derive the standard archive product; and user services to allow access to the system and distribution of data.

NOAA is actively participating in the NASA Landsat 7 Project team at Goddard Space Flight Center. In addition to the functions listed above, NOAA is investigating the use of the NOAA Command and Data Acquisition Stations for use in command and control functions, and of the functions of the Mission Management Office for overall responsibility of the Landsat 7 on-orbit operations.

The current schedule for launching Landsat 7 is late 1998.

QUESTION 10A. The dispute over whether the EOSAT contract should be opened up to competition currently is in litigation. Would you provide us with some background information on how this situation arose?

Answer 10A. The Land Remote Sensing Policy Act of 1992, P.L. No. 102–555 directed the Landsat Program Management (LPM) to negotiate data policy for Landsats 4 through 6 with EOSAT. The Act required a report to Congress if no agreement was reached by September 30, 1993.

The data policy was not signed in September 1993 and the LPM continued to negotiate with EOSAT. In April 1994, the LPM and EOSAT signed an "agreement" on market rights and data prices for Government users. On May 5, 1994, a Presidential Decision Directive was signed that made the Department of Commerce part of the Landsat Program Management with the responsibility for the operation of the present and future Landsat satellites. The General Counsel of the Department of Commerce then opened that since the LPM did not reach an agreement with EOSAT by September 30, 1993, the LPM authority for a sole-source award to EOSAT under Section 103 of P.L. No. 102–555 lapsed.

The current Contract was due to expire on July 16, 1994. Therefore, both DOC and EOSAT agreed to an extension of the present contract until December 31, 1994, which assures the continued operation of Landsat 4 and 5, at no cost to the Government. As required by the Competition in Contracting Act, in November 1994, Commerce published a notice in the Commerce Business Daily (CBD) Report, stating our intention to extend the current contract with EOSAT on a sole-source basis.

DOC Contracting Officer received three letters of interest from private companies interested in providing Landsat operations. These letters indicate that providers other than EOSAT may be capable of operating Landsats 4 and 5. Therefore, Commerce, acting upon the recommendation of counsel, decided to hold a competitive procurement for the continued operation of these satellites.

On December 27, 1994, EOSAT sought an injunction in the Federal District Court for the District of Columbia Circuit to restrain Commerce from seeking competition. A court decision is expected in March.

QUESTION 10B. Will the dispute have any impact on the operation of Landsat and the continuity of Landsat data?

Answer 10B. EOSAT continues to provide the remote sensing services under an extension of the contract until the competitive bidding process is complete and the final contract awarded—a process expected to take approximately one year.

QUESTION 11. Has the new management plan for Landsat been finalized and implemented and what is the responsibility for each agency involved in the program?

Answer 11. The new management plan for Landsat has been directed by a Presidential Decision Directive (PDD) signed by President Clinton on May 5, 1994. Under this strategy, the President directed that acquisition responsibilities for Landsat 7 would be transferred from DOD to NASA. NASA will build the Landsat 7 spacecraft and ground system, and launch the satellite. NOAA will co-manage the development of the ground system with NASA and operate the space and ground segments after in-orbit checkouts. The Department of the Interior, U.S. Geological Survey Earth Resources Observation System (EROS) Data Center, located in Sioux Falls, South Dakota will be responsible for maintaining a national archive of existing and future Landsat-type remote sensing data within the United States and make such data available to U.S. Government and other users.

QUESTION 12A. In 1992, I cosponsored the Land Remote Sensing Act (P.L. 102–555), which, among other things, authorized the Commerce Department to license private land remote sensing satellite system. How many licenses has DOC issued to date?

Answer 12A. In March 1994, the Administration announced a major policy change in the treatment of space-based satellite imagery products and system in the form of the U.S. Policy on Foreign Access to Remote Sensing Space Capabilities. To date, NOAA has issued six remote sensing licenses to operate satellite systems offering resolution as sharp as 1 meter. They are: Martin Marrietta; Eyeglass International (a consortium of Orbital Sciences Corporation, Litton's Itek Optical System Division, and GDE Systems Incorporated); Lockheed Corporation; WorldView Imaging; Ball Aerospace; and AstroVision.

QUESTION 12B. What, in your view, is the potential global market for commercial land remote sensing?

Answer 12B. The commercial sale of high resolution images from space is a rapidly growing and potentially significant sector. According to the Office of Air and Space Commerce in the Department of Commerce, U.S. companies currently lead the world in remote-sensing technology, and some who are considering entering this market estimate the market potential for such images when combined with location, demo-

graphic, and other geographic information systems, to be in the neighborhood of $5 billion, with projected growth to $15 billion by the end of this decade. The commercial applications, both in this country and in many emerging markets abroad, for fast accurate images include infrastructure management, city planning, mapping, mineral exploration, land and water use, taxation, agriculture and forestry management, flood control, fire prevention and a host of other uses.

Polar convergence

QUESTION 13. On February 6, 1995, the General Accounting Office (GAO) sent a letter report to the House Appropriations Committee regarding the feasibility and cost-effectiveness of the transfer of two DOD meteorological satellites to DOC's National Oceanic and Atmospheric Administration in the effort to merge the DOD and NOAA polar orbiting satellite programs. It was the conclusion of the GAO Report that transferring the DOD satellite to NOAA "would not be beneficial to the government." Would you comment on the report's findings and underlying analysis?

Answer 13. The Department of Commerce agrees with GAO's analyses that transfer of DOD satellites in lieu of proceeding with existing NOAA acquisition plans would not be beneficial. The convergence team, consisting of members from the Departments of Commerce and Defense and the National Aeronautics and Space Administration, evaluated a number of options on how to transition from the current program to the converged program. This study showed that flying out existing/planned satellites is the cheapest/most efficient transition to the converged satellites. This finding also correlates well with previous convergence studies which found that the most cost-effective time to converge is when a new satellite's development is planned. Now, for the first time in history, both agencies are in the planning stages of follow-on systems at approximately the same time.

On convergence matters that need to be addressed the Department would like to address each issue highlighted in the 1994 GAO Report. They are:

(1) Substantiation of short- and long-term cost savings

Vice President Gore's 1993 National Performance Review (NPR) recommended convergence of the Defense Meteorological Satellite Program (DMSP) and the NOAA Polar-orbiting Operational Environmental Satellite System (POES) and estimated near-term (five years) and long-term savings of up to $300 million and $1.3 billion, respectively. A cost estimate was initiated and completed in April 1994. This cost estimate was based on the December 1993 triagency study (DOC, DOD, and NASA) on convergence. This triagency study was based on projected DOC (NOAA O-P-Q)/DOD (DMSP Block 6) follow-on program capabilities; however, at the time no formal consolidated DOC/DOD requirements document existed. The results of this triagency study were provided in support of an OSTP study which resulted in the May 1994 Presidential Decision Directive (PDD) directing convergence. This estimate, when compared to the FY94 President's Budget for the planned follow-on programs for DOC and DOD, showed a savings of $239 million (FY95–99) as shown in Attachment 2 and the combined NPOESS Budget reflected in Attachment 3. These savings have been documented, staffed, and briefed to OMB, GAO, DOD, DOC, and HAC Survey and Investigations staff. These savings, while based on actual technical and cost analysis, are subject to change as a result of Concept Definition and Exploration studies. Such studies are currently underway and linked to a formal process to document the combined DOC/DOD requirements. The results of these efforts will be formally presented to and approved by the NPOESS Executive Committee as part of the acquisition Milestone I Review process. Upon completion of the Milestone I Review, refined near- and long-term savings will be available.

(2) Timely completion and approval of integrated operational requirements

The triagency team determined that the key to ensuring that the converged program satisfies critical civil and military operational requirements is the completion of the joint agency validated requirements document. The three agencies have agreed to use a requirements process and document patterned after that used by the DOD. The preliminary draft Integrated Operational Requirements Document (IORD), to serve as a basis for concept exploration studies, has been completed and released to the Integrated Program Office (IPO). Currently, the IPO is initiating concept exploration activities through the use of existing DMSP contracts and based on this preliminary IORD. The preliminary IORD will be updated as a result of Phase 0 studies and issued as IORD I at milestone I.

(3) Completion and approval of agency management plans

Since the IPO was established in October 1994, the initial staffing plan and designation of acting personnel in key capacities has been completed.

Development of a triagency Memorandum of Agreement is very near completion and should be ready for Secretarial signature in March-April 1995.

A Convergence Master Plan (CMP) covering the NPOESS acquisition, budget, and Command, Control and Communications (C3) transition (from DOD to NOAA NESDIS) will be submitted six months after SPD appointment for approval of the Triagency Executive Committee.

(4) Establishment of a joint budgeting and funding process

At the present time, a multi-agency approach to funding the converged system will be implemented. An agreed upon funding profile showing a 50/50 split in funding over the FYDP has been agreed upon and will be included in the MOA. Each agency will program and budget for the agreed upon split. The IPO will have primary responsibility for the development and justification of budget planning estimates. The Triagency Executive Committee will approve the annual budget request. The IPO budget planning process will be consistent with each agencies' internal budget decision making process and schedule. Appropriated funds for the converged system will be administered through the IPO.

The agencies recognize the desirability of working to a single funding stream and will continue to pursue this goal. However, we also recognize the difficulty of making such a change given the wide variety of interest to the organization involved in the budget formulation process.

(5) Resolution of European participation relative to the use of satellites to meet the 2004 convergence time frame and the execution of data denial requirements

Following the decision to converge the DOD meteorological satellites with NOAA's polar-orbiting environmental satellites, the proposed Joint Polar System agreement under negotiation with EUMETSAT was revised to take into account U.S. convergence plans. Subsequent negotiations with EUMETSAT have not surfaced any major problems relating to convergence. Europe is in the process of confirming technical and funding aspects of its program. We expect this process to be completed this fall and that an agreement with EUMETSAT can be signed later this year.

In regards to data denial, NOAA, DOD and EUMETSAT have worked out an approach that has been well received by Europe. NOAA consulted with NATO last October and with EUMETSAT's governing Council in November. No significant European problem with our data denial requirement came up. The details of how data denial would be implemented are still to be finalized in an agreement, but we don't see this to be a major problem for our planned cooperation with Europe.

(6) A plan to proceed with the transfer of DMSP's satellite control functions to NOAA

The U.S. Air Force Space Command (AFSPC) already had planned to close the two dedicated DMSP Command, Control and Communications (C3) sites at the Fairchild Satellite Operations Center (FSOC), Fairchild AFB, WA, and the Multi-Purpose Satellite Operation Center (MPSOC), Offutt AFB, NE, in FY97 and FY98, respectively. The original plan was to consolidate DMSP C3 activities at Falcon AFB, CO, but now in accordance with the Presidential Decision Directive and OSTP Convergence Implementation Plan, DMSP operations are to be transferred to DOC. The NPOESS/IPO plans on capitalizing on the AFSPC plans for site closures by ensuring that the DOC Satellite Operations Center (SOC) at Suitland, MD, will be able to assume primary responsibility for DMSP operations, while maintaining their NOAA POES and GOES responsibilities. A back-up SOC will be established at Falcon AFB, CO, for DMSP operations only. AFSPC and NOAA are developing the C3 transition procedures necessary for the orderly assumption of DMSP operations by NOAA in the 97/98 timeframe. A DMSP Operations Transfer Working Group has been established at the NPOESS/IPO. This WG is in the process of its first review of a Draft Concept of Operations (CONOPS), which includes both the transitional phase of DMSP operations, as well as operations for the NPOESS era.

[Attachments referred to above may be found in the committee's files.]

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY SECRETARY BROWN)

Technology Policy/NIST

Question 1. During last year's Senate debate on the National Competitiveness Act, there was considerable discussion about the appropriate role for the federal government in boosting U.S. industrial competitiveness. What role do you believe the Commerce Department and the rest of the federal government should play in helping U.S. industry? How important is federal support for science and technology in maintaining U.S. industrial leadership?

Answer 1. I believe the proper role of Government was best summed up ten years ago by President Reagan's Commission on Industrial Competitiveness which reported that "(I)t should be U.S. policy to strengthen our science and technology base and its application toward enhancing the technological capabilities of U.S. industry." As the Council put it, that means focusing on advancing R&D that is relevant to industrial processes and production and bringing them to bear on improving U.S. manufacturing. That is just as valid today for guiding U.S. policymaking as it was a decade ago.

Question 2. Many view NIST's technology grant program (the Advanced Technology Program) and other similar programs as promoting "industrial policy"—that is, picking winners and losers among industry sections in allocating federal grant money. They argue that the marketplace, not federal bureaucrats, should determine which R&D ventures deserve capital. How do you respond to this kind of criticism?

Answer 2. You are absolutely right that, in principle, the marketplace should determine which R&D ventures deserve capital. The problem, however, is that capital sources, such as venture capitalists, often lack the information they need to make decisions about advanced technologies, have a short time horizon, or demand control of the company up front. Instead of supplanting the market, ATP helps bring technologies to the point of development where the market can indeed make informed choices. For example, one of our grants went to a company to help it determine the technical capability of a new optics technology for controlling x-rays and neutrons and whether it was feasible to manufacture such optics. Funding to develop the technology for a specific use was not requested and would not have been granted. Once technical capabilities and manufacturability were determined, the recipient was able to take the next step of evaluating how this particular optics technology might be applied to different uses, such as health, x-ray lithography, or materials analysis and it was able to go to the private sector for follow-on financing. Our decision to help that company did not mean we thought it had a great product that the market would snap up. It reflected a judgment that the company possessed a technology that a number of different markets might be interested in pursuing if it could be brought to the point of development that would enable those markets to make educated investment decisions.

Question 3. The Japanese government practices an aggressive industrial policy where the government virtually dictates the policies of its various industries. Sometimes that approach has worked, as in the case of VCRs. However, sometimes it has not. For example, in the area of high-definition television, the Japanese industry invested heavily in analog systems, but they were quickly made obsolete by digital systems. In your view, what are the advantages and disadvantages of the Japanese approach and how does it compare with current U.S. technology policy?

Answer 3. Your example of Japanese Government support for what turned out to be an obsolete technology is an excellent one and it teaches us two very important lessons: that only somebody with enormous hubris would presume to dictate to industry what it should be making and that anybody who doubts the creativity and ingenuity of American scientists and engineers had better watch out. That is precisely why the ATP was designed to be an industry-led program in which industry submits proposals and is willing to put its money where its mouth is, or to be more genteel, to share the risk. It assumes that the great ideas will come from the private sector, not the Government, and that any support from Government should, as indicated in the previous response, be limited to bringing those ideas to the point of development where the market can make informed investment decisions about how that idea might be applied to a particular industry.

Question 4. At a time when many agencies have flat funding profiles, funding for NIST's technology programs have enjoyed phenomenal growth. For example, ATP funding went from $10 million in FY90 (its first year of funding) to $431 million in FY95. What do you say to those who would argue that these programs have grown too much, too fast?

Answer 4. NIST's programs have not grown too big, too fast. The ATP was conceived as a national program which could be expected to have national-scale impacts. The ATP's expansion has been built on a solid foundation. Indicative of its efficient operation, the ATP has grown from $10M to $431M in five years while keeping its administrative costs below 3 percent of its budget. ATP has an experienced staff and a well-established, fair, and rigorous procedure for processing and evaluating hundreds of proposals under short turnaround times. The ATP has a current pool of over 1500 technical reviewers and over 250 private-sector business reviewers from which to draw expert advice. The ATP also has a secure internal tracking system in place for protecting proprietary R&D and business plans contained in proposals submitted *by industry to ATP's general and focused competitions. To date, the ATP has received and processed many more worthwhile proposals than it has been able to fund. The ATP has digested its rapid expansion and is fully capable of further growth. Most scientists and engineers are in general agreement as to what are the ten or fifteen technologies that are likely to hold the most promise for yielding new products, new processes, new industries, and new efficiencies. There have been any number of lists of critical technologies and they are pretty similar. Some technologies will turn out to be more important that others. Your previous question cites a good example of a technology that was rendered obsolete sooner than anyone expected. Under such circumstances, the most prudent course of action for a nation with a rich and varied science and technology base such as ours is to develop as many of these key technologies as we can so that we are ready to reap the full advantages of those that turn out to be particularly valuable. Think of it as managing a balanced investment portfolio, not as picking winners. But that won't come cheap. Viewed in that context, I think that the ATP is growing at just the right pace. It allows us to address a number of technologies simultaneously and to make refinements as we go along.*

Question 5. Can you point to some tangible evidence that the NIST programs in particular, and the Administration's technology policy in general, has boosted U.S. competitiveness? Are there any areas where you believe that U.S. technology policy can be improved?

Answer 5. NIST is expending significant resources for assessments of the economic impacts of its programs. The Advanced Technology Program (ATP) and the Manufacturing Extension Partnership (MEP) are young programs. Therefore, "bottom-line" economic impact assessments are just beginning to emerge. Even so, significant impacts in terms of technologies commercialized, increased overall investment, jobs saved or created, etc. are already being documented. However, while waiting for more of these types of bottom-line assessments to become possible to complete, NIST has implemented a multi-layered impact assessment system, which includes short-term and immediate-term impact indicators. Early estimates of these latter categories of indicators show substantial positive economic impacts on a wide range of industries, including changes in R&D strategies such as more aggressive product development by company partners (ATP) and adoption of existing technologies that improve productivity.

The NIST laboratory programs, which provide industry with infrastructure technology are evaluated on a rotating basis (as resources permit). Over the past several years, NIST has undertaken a number economic impact assessments which have demonstrated very high rates of return to NIST expenditures. Economic impacts include increased R&D efficiency, higher yields on production lines, improved quality, and reduced transaction costs (the costs of actually consummating a sale of a complex, technologically advanced product or service). These impacts are achieved through the provision of infrastructure technology, such as measurement-based techniques and data, which leverage the industry's much larger investments in proprietary technology. The estimated rates of return from NIST laboratory research are turning out to be exceptionally high due to the widespread use of this technology-based infrastructure by large numbers of U.S.-based companies.

With respect to technology policy in general, one recent study by two economists at the University of North Carolina estimated that a $10 million increase in government R&D would result in a $27.5 million increase in private R&D. They also conclude from their survey that R&D personnel in firms receiving government R&D funds tended to allocate on average 15 percent more of their time to "sharing of technical knowledge."[1] *In other words, carefully constructed government technology infrastructure programs will complement and therefore increase the amount and productivity of private investment in technology.*

As to areas where U.S. technology policy can be improved, a need exists to better couple it with other elements of economic growth policy. The United States is a low-savings and low-investment economy. Over time, this trend will significantly constrain the Nation's ability to sustain acceptable rates of economic growth (witness the fact the Federal Reserve Board believes that the highest growth rate that the economy can maintain without inflation is 2.5%). Much technology is embodied in new plant and equipment. If investment is low, less of this technology gets used, and it is only through its use that long-term productivity growth can be attained.

Question 6. I understand that it is the Administration's goal to increase the current number of manufacturing technology centers and smaller efforts from 44 to 100 by 1997. Is this true and, if so, how will you decide where the new centers are to be located? What are the strengths and weaknesses of the current network of manufacturing technology centers?

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[1] D. Lzyden & A. Link, *Government's Role in Innovation*, (Kluwer, Academic Publishers, 1992).

Answer 6. It is the Administration's goal to provide small manufacturing firms across the country with access to objective manufacturing advice and assistance through a network of manufacturing extension centers. To achieve that goal, the Administration's target has been and continues to be to grow the number of centers to 100 by 1997. However, the driving force is not the number, but across-the-board access to modern manufacturing practices and technologies needed for small firms to survive and thrive in the global marketplace.

Manufacturing extension centers are selected based on a highly competitive process. Selection criteria include a clear understanding of firm needs, a correlation between the intended services and the needs of firms, leveraging of existing resources and service providers, and the organizational and management structure, evaluation plans and commitment of matching funds.

NIST MEP actively works with all states and regions that are interested in supporting their base of small manufacturers. In addition, in regions that have a high density of small manufacturers, NIST MEP has worked even more aggressively to encourage these states and regions to develop initial plans or full-blown center proposals to address their firms' needs. NIST MEP's State Technology Extension Program, also awarded through a competitive process, provides funds for states to assess the respective state or region's small firm needs, build partnerships among existing related service providers, and develop initial plans to leverage services and fill in missing service gaps. Many STEP awardees have gone on to develop successful manufacturing extension center proposals.

One of the MEP's greatest strengths is that it is designed to foster a wide variety of approaches in how manufacturing extension centers deliver services to firms. The unique needs of industry, the existing state resources, the culture inherent in a given part of the country all contribute to how a center works with the small manufacturers it serves. This strength is visible through a strong state and federal partnership.

Another strength of the national network of centers is our commitment to a core set of values. MEP is industry-driven and market-defined. MEP builds upon the foundation of existing state and local industrial extension resources. MEP awards funding using merit-based, competitive processes. MEP focuses services on activities where, in the absence of the necessary economies of scale, existing market mechanisms are prevented from affordable delivering products and services to smaller manufacturing firms. MEP focuses services on only those companies which demonstrate a commitment to investing in their own growth and development. MEP seeks maximum leverage in the development, delivery and expenditure of its program resources. MEP is committed to continuous performance measurement which focuses on the bottom-line economic impact of its client companies. MEP is committed to delivering the highest quality products and services, continuous improvement of its service delivery infrastructure, and exploring innovative and alternative approaches toward accomplishing its mission.

Current weaknesses of the national network relate to weaknesses of any start-up initiative. Centers are not accessible to all those small manufacturers that need them. We need to balance time spent with individual firms, which often produces the highest impact, versus time spent with groups of firms, which allows us to achieve greater economies of scale, but may not produce the same kind of bottom-line, measurable impact. We do not yet have in place all the systems and mechanisms, such as electronic linkages between centers, automated tools and processes, and national marketing efforts, that are needed to support such a national network. And while we pride ourselves on a rigorous evaluation process, we are working on new ways to measure the performance of manufacturing extension center-served firms vs. non-center served firms. Activities are underway in MEP to address these weaknesses.

Question 7. Some argue that the most effective way that the federal government can enhance U.S. competitiveness is through measures that do not require more taxpayers' dollars such as (a) deregulation, (b) antitrust and product liability, (c) vigorous enforcement of existing trade agreements, and (d) tax incentives. Do you agree with that assessment?

Answer 7. I certainly agree that the Government can greatly help U.S. competitiveness by maintaining a climate that is conducive to innovation and investment. That of course means using a variety of macroeconomic tools, a number of which you have mentioned. But a good climate will not necessarily direct investment dollars to advanced technologies that have not yet matured to the point where markets can make intelligent decisions about how these technologies might be applied. That's why we need a variety of tools - broad based macroeconomic tools and more focussed programs. The latter helps those technologies cross the chasm between purely basic and developmental research so that potential applications can be discerned and markets measured. Once that is done, market forces can do their job. Then its up to macro-

economic policymaking to create the climate in which investors have investment capital and are not afraid to use it.

Question 8A. I believe the emerging "information superhighway" will dramatically change the way that we work and live. Last year, I cosponsored the National Competitiveness Act, which sought to focus federal information superhighway activities on critical applications in health care, library access, manufacturing, and education. What is your sense of the future potential of the information superhighway for enhancing our competitiveness and our quality of life?

Answer 8A. If we truly want to create high-paying jobs, improve productivity, develop new markets, and enhance U.S. competitiveness, then it is imperative that we foster the development of those technologies that enable us to create, manage, manipulate and use information. The Administration's basic policy is to promote private investments and encourage competition, so that in the final analysis, it is the market that determines which technologies are most cost effective and how the information superhighways will be built. These investments will put vast amounts of information in the hands of American households and businesses that they either have no access to or cannot access easily.

Question 8B. What role is your agency playing in making the information superhighway a reality?

Answer 8B. I chair the Information Infrastructure Task Force, which was formed by the White House to articulate and implement the Administration's vision for the National Information Infrastructure, and much of the staff work and administrative support is provided by the National Telecommunications and Information Administration. The Technology Administration is proud to be a part of this important national initiative. Dr. Prabhakar, for example, chairs one of the Task Force's four principal committees, the Committee on Applications and Technology, which is charged with coordinating the Administration's efforts to develop, demonstrate and promote applications of information technology in manufacturing, education, health care, government services, libraries, environmental monitoring, electronic commerce, among others. NTIS is one of the cosponsors of the Administration's Open Electronic Meeting on Electronic Government, planned for early May, which will address issues concerned with connecting Americans to on-line government information and services.

Question 8C. What impact will the information superhighway have on rural areas like Montana and South Dakota?

Answer 8C. The Commerce Department believes that special attention must be paid to the needs of rural and other communities . If we do not, their residents will lose out on the benefits of the Information Age. Accordingly, the Department has launched a public education campaign known as "Get Connected" and rural groups are among those it has targeted. Assistant Secretary Larry Irving of NTIA has chaired a number of fora and public meetings expressly aimed at addressing how the NII initiative can address the needs of rural Americans. An example of the impact the information superhighway is having in South Dakota was recently demonstrated at NIST, by Richard Gowen, President of the South Dakota School of Mines and Technology. His organization has set up an electronic system which helps connect distant businesses.

Question 8D. In your view, what are the appropriate roles for the federal government and private industry in deploying and operating the information superhighway?

Answer 8D. The most important things the Administration can do are (1) adopt regulatory policies that promote competition among the firms that will build and operate the information highways and among the firms that sell their services and programming through the network, (2) develop and adopt a consistent Administration position on key telecommunications policy issues, such as universal service or system vulnerability, (3) address critical information policy issues, such as privacy and intellectual property, (4) develop, demonstrate and promote applications of information technology, and (5) coordinate crosscutting security issues relating to the confidentiality, integrity, and availability of information and of the systems carrying the information.

Question 9. Because of Montana's large agricultural industry, quick and accurate weather forecasts and warnings are extremely critical to my home state. For this reason, I have a strong interest in the success of the National Weather Service's ongoing $4 billion modernization effort. In general, is the modernization effort still on schedule to be completed by the end of this decade? How much of an improvement will the new system be over the current system?

Answer 9. The National Weather Service (NWS) is near the mid-point of its modernization and associated restructuring to dramatically improve the quality and reliability of its products and services. Advances in meteorology and hydrology, as well *as in the technology for observing and analyzing the atmosphere, are already providing unprecedented improvements in weather services.*

THE STATUS OF THE MAJOR COMPONENTS OF WEATHER SERVICE MODERNIZATION FOLLOWS

NEXRAD. By the end of fiscal year 1995, 133 out of 164 triagency Next Generation Weather Radars (NEXRAD) will have been deployed, with the installation of the remaining systems scheduled for fiscal year 1996.

ASOS. By the end of fiscal year 1995, 628 out of 868 triagency Automated Surface Observing Systems (ASOS) will have been deployed, with completion of the systems scheduled for fiscal years 1996/1997.

GOES. GOES-8 was successfully launched in 1994 and is fully operational. GOES-J is scheduled for launch in May 1995.

WFO Construction By the end of fiscal year 1995, construction of 108 out of 118 future Weather Forecast Offices will have been completed. The remaining WFOs are scheduled for completion in fiscal years 1996/1997.

Staffing. By the end of fiscal year 1995, 98 out of the 118 future Weather Forecast Offices will be fully staffed for NEXRAD operations. In fiscal year 1996, the remaining offices will be staffed for NEXRAD operations and a limited number of offices will begin to staff for Advanced Weather Interactive Processing System (AWIPS) operations.

AWIPS. Based on the recommendations of an independent assessment of the Advanced Weather Interactive Processing System (AWIPS) program, a restructuring was recently implemented. By the end of fiscal year 1995, the system design and deployment of early prototypes will be completed. Development activities will continue through fiscal year 1996 and a nationwide deployment is planned to begin in fiscal year 1997.

Based on the expected availability of staff and systems, a nationwide network of 118 WFOs and 13 RFCs will be operational by the end of 1999. Completion of the restructuring is expected by the end of the year 2000.

Recent data compiled on accuracy and timeliness of NWS warnings continue to show marked improvements using the latest technology. For example, severe weather warnings have improved from near 60 percent detection under the old radar umbrella to more than 80 percent using the NEXRAD. Lead times for these severe weather warnings have also improved with advanced warning of 8 minutes or more for the most damaging storms. Contrast that with an average lead time of about 4 minutes using the older technology. Further improvements are expected as the modernization progresses and additional technologies, such as GOES, NEXRAD and ASOS, become operational and AWIPS is installed at each new weather office. In addition, the new technology systems will continue to improve weather forecasts and warnings as we maximize research efforts to integrate and better utilize new data sets into the forecast process.

Question 10. Many Congressional Committees, including this one, are trying to determine whether certain current government programs and activities can be more cost-effectively performed by the private sector. Has your agency studied whether any NOAA programs, particularly the Weather Service programs, might be "privatized"?

Answer 10. The National Weather Service and the private sector established a partnership in the 1980's that defined the public and the private sector roles to ensure that the Nation receives the full benefit of weather and hydrometeorological information to promote protection of life and property and economic prosperity. The private sector is responsible for the specific tailoring of NWS data and information for users and NWS has assisted in the development of this industry, now estimated to be over $200 million.

A number of functions previously performed by NWS have been successfully spun-off to the private sector such as newspaper weather "pages" and direct commercial radio weather broadcasts. Included in the President's fiscal year 1996 budget submission are four additional programs proposed for commercialization: agricultural, fruit frost, marine facsimile broadcast services and some specialized fire weather services.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY DR. GOOD AND DR. PRABHAKAR

Question 1. What do you see as the most important mission of the Technology Administration and NIST? Within NIST, what do you view as more essential—your inhouse laboratory research or your outside technology grant and assistance programs? What are some of the more promising research projects being undertaken at the NIST labs?

Dr. Good's Answer 1.

We think that private sector innovation, along with expanded markets for U.S. exports, a skilled and flexible workforce, and a sound climate for private investment are the four pillars supporting sustained economic growth and opportunity in the United States. Each of these components is essential; and a set of policies to strengthen any one of them must take place within a framework that addresses all of them. I think that every federal department is working, in one way or another to strengthen one or more of these pillars. But the Technology Administration is the only federal entity whose only business is to assess and support the Nation's civilian technology base. We make sure that the Commerce Department's customers—that is, American business and industry—have an aggressive advocate in the development and coordination of Administration-wide technology efforts; and that these policies and programs expand economic opportunity for all Americans.

We believe we have a responsibility to promote technology partnerships with industry, which help bridge the investment gap between shorter- and longer-term research; to ensure access to existing technologies through manufacturing extension services; to make government, scientific and technical, and business information widely available to the public; to help U.S. companies gain access to valuable foreign science and technology; and to promote a business climate that fosters private-sector innovation and maximizes its impact on economic growth.

Dr. Prabhakar's Answer 1.

NIST's mission is straightforward and unique. As part of the Commerce Department's Technology Administration, NIST promotes U.S. economic growth by working with industry to develop and apply technology, measurements and standards—providing the basic technical infrastructure needed by U.S. industry. We concentrate on industry because it is industry that transforms technology into the products and services, the profits and jobs that yield the returns to American taxpayers. All parts of NIST are essential for accomplishing this job - each part focuses on a different important aspect of national industrial needs.

NIST's laboratory programs have long been recognized for their practical assistance to industry and their focus on infrastructural technologies that support our economy. Our laboratory efforts are planned and implemented in cooperation with industry and focused on infrastructural technologies such as measurements, evaluated data, standards and test methods which provide a common language for use by industry in commerce. Industry traditionally under invests in the development of these infrastructural technologies because they are used simultaneously by many firms. These infrastructural technologies typically are not embodied in products, making it difficult or impossible for individual firms or even industries to recover the R&D investment it would take in order to develop these technologies. The benefits from this work are spread across many companies and industries, and the economic impact can be great.

Despite early concerns that the new NIST extramural programs might detract from the traditional laboratory mission, we have ample evidence today that the new programs, particularly ATP, have strengthened our laboratory efforts on behalf of industry. This is reflected both in the increasing laboratory budget and in the reinvigoration of the labs' technical efforts. The laboratory/ATP interaction has provided new windows through which the laboratories can view the potential impact of their work on the economy, allowing a better perspective for program planning. The interactions between the laboratory programs and the ATP have also increased the exchange of ideas and collaboration between the labs and numerous industrial partners.

The budget increases have permitted NIST to strengthen our core capability for infrastructural technologies. We have accomplished this without increasing our staff. Those who were working to support other agencies' needs have shifted to NIST funding so that they may respond even more directly to industry needs. Also, planning is underway for the renovations and new construction that are vital if the labs are to meet industry's needs in the coming century.

I am particularly proud of these accomplishments from our laboratory programs:

- We have been able to more aggressively tackle industry's growing infrastructural technology needs in emerging areas of technology. For example, two areas where we are bringing greater resources to bear are in biotechnology and information technologies. Both are clearly huge growth areas for industry, and neither can move ahead easily without the kinds of underlying research and services done by the NIST laboratories.
- *The underlying base for metrology, the science of measurements, has been revitalized. For example, our scientists recently trained an array of four lasers on cesium atoms, trapping and cooling them to within 700 billionths of a degree of absolute*

zero, the coldest temperature ever reported for an atom measured in three dimensions. This accomplishment eventually may lead to improvements in the accuracy of atomic clocks; each past improvement has led to almost immediate technological applications, from synchronizing telecommunications and electrical power grids to the Global Positioning Systems.

- *Faced with the imminent elimination of ozone-destroying chlorofluorocarbons (CFCs) and the phaseout of related refrigerants, the Nation's $17 billion air conditioning and refrigeration industry now is using a NIST-developed database which calculates key thermophysical properties of 38 refrigerants and mixtures. In the search for cooling systems that are both environmentally and economically acceptable, industry needed high-quality data. An official of the Air-Conditioning and Refrigeration Institute, an industry association, said, "Without NIST, we would have gotten less detailed data, which would have meant a lot more expensive, time-consuming engineering work to produce hardware. It would have cost us millions more."*
- *A NIST tool for quickly evaluating the performance of coordinate measuring machines—used by many manufacturers to check the dimensions of parts and assemblies—is helping U.S. firms to improve their quality assurance methods and cut costs. Manufacturers now can comprehensively and quickly assess CMM performance, decreasing the chances that companies will ship poor-quality parts to their customers or scrap good parts mistakenly. Evaluated by Caterpillar Inc. and Boeing, the NIST tool has been commercialized by Giddings and Lewis, a U.S. maker of these measuring machines and machine tools. The product was introduced last year, and already has markets in the aerospace, automotive and heavy equipment industries.*
- *NIST recently issued a standard optical fiber that is helping U.S. fiber makers to reduce product variability and greatly improve the likelihood that spliced fibers will align precisely—ensuring the high quality transmission of signals that their customers expect. An official with Corning, Inc. reports that this capability has given "Corning and other fiber manufacturers a clear competitive edge."*

Our laboratories' formal linkages with industry remain as strong as ever. During the past year, NIST entered into 133 new Cooperative R&D Agreements, or CRADAs. Of NIST's 500-plus CRADA partners since 1988, 40 percent have been small businesses, 45 percent have been large or mid-sized firms, and 15 percent have been universities and other organizations. On average, one technical staff member in five is engaged in a CRADA—just one indicator of industrial interactions.

Question 2. How important is the Advanced Technology Program (ATP) to federal technology policy? What are some of the more prominent "success stories" that the program has produced since it was first funded in FY90?

Answer 2. The Advanced Technology Program is a rigorously competitive program which invests in cost-shared research by individual companies or industry-led joint ventures. The sole aim is to develop high-risk, potentially high-payoff enabling technologies that otherwise would not be pursued at all or in the same market-critical time frame because of technical risks and other obstacles that discourage private-sector investment. These other obstacles include long pay-back horizons, or anticipated returns that are distributed so that individual firms or specific industrial sectors are reluctant to invest.

But there is something much more fundamental about the ATP. Many people tend to focus on the individual companies that have competed for ATP awards—when what we really should be zeroing in on are the benefits to the economy as a whole. Our criteria for individual projects and entire focused programs make it very clear that we are seeking to promote industry's ability to make technology changing effort that will have broad economic impacts. The benefits that we are seeking will accrue not just to individual ATP participants, but to entire industrial sectors and the economy as a whole

Take our focused program in Information Infrastructure for Health Care. The ATP will help industry lay the foundation for the more efficient use of computer technology in doctor's offices, hospitals and clinics by cost-sharing with industry the development of innovative new enabling technologies—technologies that will allow the medical community to reduce paperwork, improve the quality of diagnosis and treatment, and bring better medical care to rural areas. This program includes, for example, figuring out ways to transfer complex medical records instantly from one facility to another even though those facilities use different record formats and different computer systems. The beneficiaries of this ATP-focused program extend well beyond the individual companies and consortia that are cost-sharing and conducting the research. If the technical challenges can be overcome, the benefits will reverberate throughout the economy and the beneficiaries will be our entire citizenry, which ultimately picks up the $1 trillion annual tab for medical spending. A full 20 percent of today's Health Care costs is related to the processing of information, and informa-

tion technology is an important ingredient for reducing those costs by many billions of dollars.

Descriptions of several "success stories" are attached.

Question 3. To scientists, researchers, or small businessmen in Montana, how would you explain why the ATP may be useful to them?

Answer 3. ATP promotes a government partnership with industry to reduce early technical barriers which, in turn, may ultimately unlock broad based commercial benefits. All for-profit companies are eligible to submit proposals and receive funding to conduct high risk enabling research in topic areas which they define. The companies share in the funding of individual projects, conduct the research and development, and are ultimately responsible for commercialization of results. Under ATP, companies are free to team with universities, federal laboratories and non-profit research and development entities. The project selection process provides an absolutely level playing field, treats all companies the same, and is rigorously competitive based on published technical and business planning criteria. The key here is that ATP provides a stable source of support for a short, but sufficient duration, to address and possibly defeat technical barriers which now limit the competitiveness of individual companies. Leadership is derived directly from industry and there is no barrier to any company participating if their interest is enabling research and development with a long-term commercial focus.

Question 4A. Last year, the ATP came under attack during the two-week Senate debate on the National Competitiveness Act. As you know, that bill called for dramatic increases in funding for NIST's technology programs. Even though the bill was not enacted, ATP funding went from $200 million in FY94 to $431 million in FY95. Is it valid to suggest the ATP may be growing too big, too fast?

Answer 4A. From its inception, the ATP was conceived as a national program, and it was designed accordingly with the Administration's plan aiming for a $750M program in FY 97. Therefore, the ATP's expansion has been built on a solid foundation. Indicative of its efficient operation, the ATP has grown from $10M to $431M in five years while keeping its administrative costs below three percent of its budget. When faced with a near tripling of our budget in FY 1994, we held 6 rather than 1 competition, and cut the average time necessary to review proposals and make funding decisions by 50 percent. We increased our staff with a broad selection of technical and business specialists, mostly from industry, integrated that staff into our processes, and realized a substantial improvement in the efficiencies of those processes. ATP now has an experienced staff and a well-established, fair and rigorous procedure for processing and evaluating hundreds of proposals under short turnaround times. The ATP has a current pool of over 1500 technical reviewers and over 250 private-sector business reviewers from which to draw expert advice. The ATP also has a secure internal tracking system in place for protecting proprietary R&D and business plans contained in proposals submitted by industry to ATP's general and focused competitions. To date, the ATP has received and processed many more worthwhile proposals than it has been able to fund. The ATP has digested its rapid expansion and is fully capable of further growth. Furthermore, this level of growth is essential to providing a balanced "investment portfolio" for our diverse technological base.

Question 4B. Do you agree that the ATP should have to produce tangible results before the Congress considers further expansion of the program?

Answer 4B. The strongest argument against slowing planned program growth is the overwhelming support for ATP among industrial leaders who are facing daily technology-based competition in the world marketplace. A flat budget would destroy the momentum created for a new type of industry-led industry, government, university partnership; a partnership with appropriate roles, appropriate goals and exciting prospects for U.S. economic growth.

The goal of the ATP is to promote economic growth by working with industry to develop high-risk, potentially high-payoff, enabling technologies. Implicit in this goal is the understanding that the ultimate payoff—economic growth—will follow the introduction of new products and processes after completion of the ATP-sponsored R&D. Since the ATP is a new program, most of its projects are still very much in the research or pre-product development phase. Nevertheless, several of the ATP projects are already producing breakthrough technologies and tangible benefits.

Examples of breakthrough technologies being developed with the help of the ATP are:

- *ion implantation to enable significant productivity improvement in the U.S. semiconductor industry;*
- *technology to produce revolutionary true-green light-emitting diodes provides high capacity solutions in optical storage and communications, and applications in flat panel displays;*

- *special optical crystals that will vastly increase the number of signals that can be transmitted in fiber optic communications; and*
- *prosthetic tissue woven like cloth to form biodegradable implants may serve as a matrix on which the body's own cells could grow to replace damaged tissues.*

Other tangible benefits of the ATP program are:

- *Promoting industry alliances. The ATP is encouraging industry to form cooperative R&D ventures for large projects. Alliances are forming among competitors, and among customers and suppliers. Sixty-one of ATP's 177 awards have gone to joint ventures and most or all of these were formed specifically for the ATP project. In addition, there are myriad informal alliances and subcontractor arrangements in both single applicant and joint venture projects.*

Question 4C. What would be the impact on NIST if it faced a flat budget profile over the next few years?

Answer 4C. The majority of ATP funds are committed to focused program areas, established in concert with industry, that concentrate support on major research and business goals in key technologies over a period of several years. ATP-focused programs generally require a number of independent R&D projects that complement and reinforce each other. Each program area sponsors a series of competitions specific to that area. The ATP already has announced 11 focused programs in:

- *Tools for DNA Diagnostics*
- *Catalysis and BioCatalysis Technologies*
- *Materials Processing for Heavy Manufacturing*
- *Motor-Vehicle Manufacturing*
- *Advanced Vapor-Compression Refrigeration*
- *Component-Based Software*
- *Digital Video in Information Networks*
- *Digital Data Storage*
- *Information Infrastructure for Health Care*
- *Manufacturing Composite Structures, and*
- *Computer-Integrated Manufacturing for Electronics*

Focused programs are developed based on suggestions from industry submitted in "white papers," workshops, conferences and other mechanisms to select those areas with the greatest potential for economic benefit to the United States, and to reach a consensus on the specific R&D and business goals to be set for each program.

A flat budget would essentially eliminate future focused programs from being launched, retard the ability to fully support the programs already launched, and possibly cause ATP to terminate ongoing programs. It would also cause industry to back away from the planning process since there is no incentive to promote specific investments. Most importantly, flat funding at the current level would destroy the momentum we have built in tackling and defeating well-recognized high-risk barriers in many industries in a time frame which clearly establishes U.S. industry leadership. As the research focus of companies becomes properly focused on nearer term, product-oriented objectives in the face of brutal global competitiveness, the ability to sustain high-risk enabling research is one of the keys to future growth, and the ATP's role in sustaining this type of research will be greatly diminished under flat funding.

Question 4D. What would be the impact on NIST, and federal technology policy, if the ATP were eliminated?

Answer 4D. The immediate impact on NIST would be the elimination of about 135 positions. This includes ATP program staff and scientists and engineers involved in related laboratory support. In terms of the federal technology policy, ATP represents a critical part of the federal government's R&D budget. It is the only portion dedicated to the development of early-stage, precompetitive civilian technologies. Elimination of ATP would destroy progress made in encouraging far-looking, risk-sharing research and development of new enabling technologies.

Industry's reluctance to pursue long-term high-risk research and development of enabling technologies is well documented, as is the need for such technologies to fuel future economic growth. The ATP has proven to be an effective mechanism for encouraging companies to look farther out onto the technology horizon. The ATP would be discarded, even though it is working.

Elimination of the ATP would destroy momentum created for a new type of industry-led, industry, government, university partnership; a partnership with appropriate roles, appropriate goals, and exciting prospects for U.S. economic growth.

Government and industry have already made substantial commitments to the ATP program. Its demise would show the government to be a capricious, unreliable partner.

Question 5. Many call the ATP an example of "industrial policy" where the government, through awarding grants, picks winners and losers among technologies. Do you think that the ATP, as well as similar grant programs, represent industrial policy? Is it your view that the federal government, rather than the marketplace, should determine which high-tech ventures are funded and which are not?

Answer 5. ATP is industry-oriented. While government provides the catalyst—and in many cases, critical technical support—industry conceives, manages, and executes each ATP project. Industry proposals are based on the private sector's understanding of market trends and future opportunities. All projects are selected on the basis of both technical and business merit through a fair and rigorous competition that draws on both government and private sector expert reviewers.

It remains fashionable to talk about "picking winners and losers." That phrase truly yields more heat than light. In one sense, "picking winners and losers" is the old way of setting federal R&D priorities. The federal government long ago picked agriculture, aeronautics, space, energy and health. The whole point of the ATP is to maximize economic impact by letting industry's ideas—backed up by their financial commitment—determine what is funded. That is the new concept in federal R&D that is embodied in the ATP.

Suggesting that programs like the ATP pick winners and losers also underrates the tremendous efforts of our industries. Consider what it really takes for a company to make a winner in the market: product development, manufacturing and production, global marketing and sales, distribution and service systems. All of these jobs belong to industry, and ATP is doing none of them. ATP's job is to cost-share the high-risk, enabling R&D that is upstream of product development, creating new opportunities for companies to pursue.

The acid test is simple: ask any ATP participant what it will take to launch a successful product in the marketplace beyond the work being performed with government-provided funding. Their own investments will always be substantially larger than the government's relatively small cost-shared funding. And that added investment comes not from the ATP, but from the private sector.

Question 6. Some have said that the ATP amounts to a government subsidy for U.S. industry that is not different that the European Airbus-type subsides that GATT was intended to curb. How do you respond to their criticism?

Answer 6. The Advanced Technology Program is not a government subsidy. The ATP is a rigorously competitive program which invests in cost-shared research by individual companies or industry-led joint ventures. Industry contributes its own resources to the project by matching or exceeding the federal investment. The sole aim is to develop high-risk, potentially high-payoff enabling technologies that otherwise would not be pursued at all or in the same market-critical time frame because of technical risks and other obstacles that discourage private-sector investment. These other obstacles include long pay-back horizons, or anticipated returns that are distributed so that individual firms or specific industrial sectors are reluctant to invest.

The ATP does not invest in product development, manufacturing and production, global marketing and sales, distribution and service systems. All of these jobs belong to industry, and ATP is doing none of them. ATP's job is to cost-share the high-risk, enabling R&D that is upstream of product development, creating new opportunities for companies to pursue.

ATP is industry-oriented. While government provides the catalyst—and in many cases, critical technical support—industry conceives, manages, and executes each ATP project. Industry proposals are based on the private sector's understanding of market trends and future opportunities. All projects are selected on the basis of both technical and business merit through a fair and rigorous competition that draws on both government and private sector expert reviewers.

Question 7. It has been argued that any national strategy for making U.S. industry more competitive must include antitrust reform, product liability reform, tax incentives, and effective enforcement of existing trade agreements. Do you agree with that assessment?

Answer 7. We need all of them.

The Clinton Administration is pursuing a four-part competitiveness strategy emphasizing skills and training, increasing our rate of private investment, opening world markets, and promoting technological innovation. All of the issues raised in your question are vital parts of our competitiveness strategy.

Our strategy recognizes that there is no "one size fits all" formula for ensuring that our companies lead the world in innovation. We are addressing the broad range of factors that affect our companies' ability to develop technology, turn innovations into products and services, and bring them to global markets. These issues include capital availability, strengthening intellectual property protection, reforming regulatory barriers to innovation, and reducing Cold War export controls.

Each of the four pillars of our competitiveness strategy—skills, investment, trade, and innovation—are important to our nation's long-term economic growth, and each cannot serve as substitutes for another. For example, the business environment and *trade elements listed in your question deal with different problems from those addressed by the technology infrastructure initiatives of the Department and the Administration. In particular , tax incentives are not an effective substitute for the ATP because they do not address the barriers to high-risk research and development of enabling technologies.*

Question 8. NIST supports seven regional Manufacturing Technology Centers, as well as smaller technology transfer centers, to help small- and medium-sized manufacturing plants modernize their operations. How effective have these centers been in assisting these businesses? Can you provide any specific examples of businesses that have been helped by the centers?

Answer 8. Having a nationwide system managed through NIST offers the centers a system-wide array of supporting services and information resources—and discourages duplication of effort. As conduits to MEP client companies, the centers can increase the depth and breadth of expertise readily available to local firms.

As the client companies become more competitive, their prospects for long-term growth improve. So do opportunities for retaining existing jobs, creating new high-skill, high-wage jobs and reaping economic benefits related to maintaining America's value-added manufacturing industry, and additional service industry jobs needed to support that manufacturing base.

In 1993, fewer than 1 in 20 smaller manufacturers were located within the service areas of the seven federally sponsored extension centers. Since then, dramatic progress has been made. Now, 44 MEP centers are operating or are preparing to open their doors in 32 states. Those non-profit centers employ professional engineers and others with manufacturing or business experience who are opening their doors to information and expertise for small manufacturers.

Several examples of businesses that have been helped by the Centers are attached.

Question 9. Assume that I have a small manufacturing plant in Montana with outdated equipment and practices. How would I seek help from the Manufacturing Technology Centers? Would you take me through the bureaucratic process, step-by-step?

Answer 9. There is no manufacturing extension center located in Montana, currently. However, NIST MEP has been working with a representative from Montana State University and with the State's Science and Technology Advisor on developing plans for better serving the state's small manufacturing base in the future. Montana received funding and assistance through NIST MEP's State Technology Extension Program in 1991 in order to develop a strategic plan and overall assessment of the state's small manufacturers' needs. It is hoped that Montana will be among the states submitting a proposal in the next NIST MEP solicitation for manufacturing extension centers.

In any state where there is an existing center, assistance from that manufacturing extension center is only a phone call away. Because centers typically partner with and are networked through a variety of other public and private sector organizations—including manufacturing-related trade associations, Small Business Development Centers, community and technical colleges, and economic developers, the center's phone number and basic information about the center is often available through these organizations.

But, very often, even picking up the phone is not necessary. That's because MEP manufacturing extension centers are actively contacting and calling on small manufacturing firms to familiarize the firms with services available to them and to start developing a substantive working relationship. Most centers also hold workshops and seminars on manufacturing techniques and technologies, using mailings to both customer and non-customer firms to notify them. In addition, many centers indicate that they receive phone calls from firms through word-of-mouth referral from satisfied small firm customers.

Regardless of how it's made, once contact between a firm and a center is established, work begins. There is NO bureaucratic process to be undertaken; no forms to be filled out by a firm in order for assistance to be provided. Manufacturing extension centers are not federal government agencies, but not-for-profit organizations designed to serve small manufacturers. Their goal is to overcome barriers to firms knowing about and using technologies and information, not add to those barriers. And, assistance is available to ALL small manufacturers located in the centers' service region.

Assistance provided by the center depends on the needs expressed by the firm. In some cases, that assistance may begin by helping the company address a specific, short-term project or solve an immediate problem. In other cases, assistance may begin with the center conducting an overall assessment of the firm's operations. These assessments identify opportunities for improvement within the firm. Manufacturing center staff help firms prioritize steps needed to implement those improvements, often *bringing in existing public and private sector resources that have additional needed expertise.*

Centers DO ask companies for help in evaluating and measuring the impact that center services have on firm performance. This bottom-line feedback is important for centers to track their effectiveness, and for centers to report their results to state and federal sponsors. Companies provide only results that they feel are attributable to their interaction with the manufacturing extension center.

Question 10. I understand that the Administration plans to develop a network of 100 Manufacturing Technology Centers by the year 1997. Is that still the Administrations plan and, if so, where will you get the money for it?

Answer 10. Yes, it still is the Administration's plan to develop a network of 100 Manufacturing Technology Centers by 1997. We will seek appropriate funding through the appropriations process and through matching Center contributions.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY DR. BAKER

Question 1. Dr. Baker, what is the status of the National Weather Service's modernization effort? What is the status of the modernization plan; what is your expected completion date; and how much needs to be done before completion?

Answer 1. See response to Question #9 submitted to Secretary Brown.

Question 2. Dr. Baker, what is the status of the training activities that the NWS is conducting to enable Weather Service personnel to effectively use the new radar and weather data processing technologies?

Answer 2. The National Weather Service (NWS) has dramatically increased its training activities to prepare its workforce to effectively operate and maintain the new technology systems such as NEXRAD, ASOS, and AWIPS.

The NWS has nearly doubled the number of classes at the NWS Training Center in Kansas City, Missouri, by offering courses to maintain the hardware and software for the new technologies and job-specific courses tailored to the duties of new positions in the modernized NWS.

The NWS conducts training at state-of-the-art training facilities in Norman, Oklahoma and Boulder, Colorado. The Operational Support Facility in Norman, Oklahoma, provides a 4-week Operations Training Course on the use of the NEXRAD and interpretation of products. By 1996, all 2000 NWS meteorologists and hydrologists who operationally use the radar in Weather Forecast Offices and River Forecast Centers across the country will have completed this course.

In partnership with the university community, the NWS has established the Cooperative Program for Operational Meteorology, Education and Training (COMET) as part of the University Corporation for Atmospheric Research in Boulder, Colorado. COMET fosters partnerships between the academic community and NWS offices for education of the Science and Operations Officers (SOOs) and for small joint applied research and training projects focused on operational weather forecast problems. COMET also produces highly interactive, computer-based learning materials that are used by the SOOs to help educate the entire NWS workforce on the latest scientific understandings now possible with the new modernization technologies.

Question 3. Public Law 102-567 requires that the Secretary of Commerce certify that there will be no degradation in service before any weather office may be closed or consolidated. If Congress were to eliminate this certification requirement, what would be the impact on (a) the cost of the modernization activities and (b) the public's interest in continuous quick and accurate weather warnings and forecasts?

Answer 3. The Administration is not advocating full repeal of Title VII of Public Law No. 102-567, the Weather Service Modernization Act. As part of the Vice President's National Performance Review and the Reinventing Government initiative, the Administration is looking at ways to streamline the certification process to reduce unnecessary costs. We are currently reviewing different options and expect to have a recommendation to forward to the Vice President for review shortly. Examples of possible streamlining measures include: (1) elimination of the current requirement that each certification be published for a 60-day comment period, and (2) elimination of the mandatory requirement for liaison officers in every service area.

In summary, the effect of streamlining the transition process would be to reduce costs in fiscal year 1996 and beyond. The estimate of savings (budget authority) resulting from such streamlining totals $27.9 million for fiscal years 1996 through 2000. This reduction would result from significantly shortening the time between when the National Weather Service can assure no degradation from an operational standpoint, and the Secretary actually transmits the certification to Congress. If Congress were to repeal Title VII entirely, it is estimated that at least $35.1 million could be saved between FY 1996 and the end of the transition period.

Question 4. Is the ongoing installation of the new NEXRAD radars on schedule and within budget so far?

Answer 4. Yes, the NEXRAD program is on schedule and within budget. By the end of fiscal year 1995, 133 out of 164 triagency Next Generation Weather Radars (NEXRAD) will have been deployed. The remaining systems are scheduled for installation in fiscal year 1996.

Question 5. Do you believe that currently planned NEXRAD radar coverage is adequate and will safely address what is necessary to be able to forecast the nation's weather?

Answer 5. Because of public concerns about the adequacy of radar coverage in the modernized NWS, the Secretary of Commerce commissioned an independent study by the National Academy of Science's National Research Council (NRC) in October 1994. On November 4, 1994, comments were requested from the public on service areas where concerns have been expressed that modernization actions taken by the NWS could degrade existing weather services. Over 67,000 comments were received by NWS and forwarded to the NRC. The comment period closed on January 3, 1995, and a total of 32 areas of concern were identified. A Federal Register notice listing these areas of concern was published on February 23, 1995.

The NRC is currently conducting an independent scientific assessment of proposed NEXRAD radar coverage and consolidation of field offices in terms of the "no degradation of service" requirement of Public Law No. 102-567. In conducting this study, the NRC will consider public comments about NWS modernization and establish criteria for identifying service areas where the decommissioning of existing radars could degrade service. The NRC will document its findings and recommendations in a report to the Secretary of Commerce, expected in May 1995.

Taking into account public comments received, the Secretary of Commerce will then apply the NRC's criteria, plus applicable modernization criteria previously endorsed by the NRC, to the 32 areas of concern that were identified as a result of the public comments. The Secretary will identify at what locations, if any, actions to decommission a radar, or to close, consolidate, relocate, or automate a field office are not likely to satisfy the "no degradation of service" requirement of Public Law No. 102-567. The Secretary will report his findings and recommendations, including any necessary adjustments to the NWS modernization plan, to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science of the House of Representatives. The estimated time frame for this report is Fall 1995.

Even after the above study and report have been completed, the Secretary must still certify "no degradation of service" before NWS offices can be closed, consolidated, relocated, or automated.

Question 6. There are some who contend that the National Weather Service needs to add about 6 to 7 more NEXRADs to provide full radar coverage without any gaps. Would you comment on this?

Answer 6. See response to Question #5 above.

Question 7. I understand that the Advanced Weather Interactive Processing System (AWIPS) will allow the forecasters for the first time to view and analyze integrated radar, satellite, and ground station data. What impact will this new system have on weather forecasting? How reliable has AWIPS been in actual service and can it be depended on to provide actual working forecasters with the data that they need to do their jobs?

Answer 7. AWIPS will dramatically increase the accuracy and reliability of short-term warning and forecast services, much as the advanced observing technologies (e.g., NEXRAD) have done. Satellite imagery, radar imagery, surface and upper air observations, and model output will be integrated within a single workstation. This integrated environment will for the first time provide a consistent, high-quality representation of the state of the atmosphere for forecast and warnings purposes. In addition, the local dissemination capabilities of AWIPS will improve our ability to provide warnings and forecasts to the emergency management community and the media. Development activities will continue through fiscal year 1996 and a nationwide deployment is planned to begin in fiscal year 1997.

AWIPS-like prototypes developed at NOAA's Forecast Systems Laboratory have been used operationally in Denver, Colorado, since 1987 and in Norman, Oklahoma, since 1991. These prototypes have been proven to be extremely reliable. Our extensive experience with AWIPS-like prototypes and future testing with AWIPS developmental systems will provide the necessary assurance that forecasters will have the data they need to do their job.

Question 8. The new satellite, radar, and surface observing technologies will produce substantially more data than Weather Service employees have had to deal with in the past. One of the things AWIPS was designed to address was this tidal wave of new data. Will AWIPS be useful in being able to filter and manipulate this flood of new data? In your demonstrations of AWIPS, do the forecasters find that AWIPS turns the data into meaningful knowledge for the forecasters?

Answer 8. While NWS forecasters will have access to a great deal more data in the modernized Weather Forecast Office, for the first time these data will be available in an integrated workstation environment. On a single display, a forecaster will be able to view numerous data sets simultaneously. In addition, the full suite of defined AWIPS capabilities will provide the productivity tools to enable the forecaster to perform data filtering and manipulation.

Forecasters using the AWIPS prototypes at Denver and Norman have found that the capability to deal with satellite and radar imagery, observational data, and model guidance graphics on the same workstation allows a much more successful integration of these data types into their evaluation of current and expected atmospheric conditions. Visible evidence of phenomena suggested by model guidance can be provided by satellite or radar data. Used in tandem, the combination of data from numerous sources dramatically improves the forecasters' ability to understand current and future weather conditions to provide more accurate forecasts and warnings.

Question 9. Dr. Baker, I realize that you cannot comment directly on the President's FY96 budget submission expected next week. However, let me ask you this: if NOAA were to receive in FY96 the same funding level that it received for FY95, what, in your opinion, would be the resulting impact on your programs and employee levels?

Answer 9. If Congress provides NOAA with a "flat" budget, we would review all of our programs for decreases, but at this time we do not have any specific programs so identified.

A flat budget could impact areas such as National Weather Service offices, fisheries and research labs which, in turn, would require adverse personnel actions such as Reductions-in-Force (RIFs) or furlough of NOAA employees.

Also, both the NWS systems and our current suite of environmental satellites, which provide the basis for accurate weather forecasts and the local weather broadcasts, would be negatively impacted. These major system areas are extremely vulnerable in any reduction

exercise as they represent long-term capital investments and their funding is based on contracts and firm schedules.

Question 10. Dr. Baker, I understand that the new Automated Surface Observing System (ASOS) will dramatically reduce the number of personnel needed to perform weather observations. However, in the past year, we have heard reports that, in demonstrations, ASOS installations have had problems so severe that NOAA and the National Weather Service have halted further ASOS installations until these problems can be resolved. What was the exact nature of these problems? Can they be fixed? What will be the cost and schedule impacts on installing the ASOS units?

Answer 10. The National Weather Service did not halt installations of ASOS systems, but rather temporarily delayed commissioning of ASOS units last fall. After conducting a readiness review in March of this year, the NWS has resumed commissioning in April 1995. Under the current plan, 10-20 ASOS commissionings are expected during the next 60 days. The commissioning rate is planned to increase to 25 to 30 per month from July 1995 onward.

ASOS commissionings were temporarily halted in order to allow for the correction of deficiencies in a number of sensors for which modifications by the contractor were underway and to enable the buildup of an adequate reserve of logistics. Commissioning is resuming because a majority of the required sensor modifications will be fielded shortly and the required logistics are now at a manageable level.

No significant cost or schedule impacts were incurred from the temporary delay in commissioning.

Question 11. There are some suggestions that, while the ASOS has been meeting its specifications, those specifications are just not enough to guarantee that ASOS can take the place of trained human observers. How would you respond to these assertions?

Answer 11. ASOS was never intended as the sole source of surface weather data. Pursuant to a 1988 Memorandum of Agreement between the Federal Aviation Administration (FAA) and the NWS, ASOS was not designed to provide all measurements that are important to aviation. It was understood that there would be a continuing need to "augment" ASOS observations with human observers until the ASOS data could be supplemented by products derived from other remote automated systems (e.g., satellite cloud products, NEXRAD, and lightning data network products). Efforts to develop these additional data products are underway. ASOS observations will continue to be "augmented" by human observers, at those sites required by the aviation community, until the additional data products are available and their use *is fully understood. The exact combination of NWS, FAA, and contract observers required in the immediate future is still being determined.*

Question 12. Dr. Baker, in our effort to reduce the federal deficit, we are constantly looking for federal programs that could be more cost-effectively provided by the private sectors. At NOAA, particularly within the Weather Service, are there any areas that you believe can be "privatized"?

Answer 12. See response to Question #10 submitted to Secretary Brown.

Question 13. In the past, the procurement of new "GOES" weather satellites was plagued by technical problems, cost overruns, and schedule delays. However, it would appear those problems are now behind you. What is the current status of the GOES program and what lessons did NOAA and NASA learn from the past problems about satellite procurement?

Answer 13. Since the GOES program was restructured in 1991, all of the significant technical issues have been resolved, and we have been running somewhat ahead of schedule and on-budget. New problems are being dealt with expeditiously as they arise. A strong NASA/NOAA/Contractor team is now in place.

From the procurement problems encountered from the GOES program, NOAA and NASA have learned:

- *Never to conduct a new development program in series with an ongoing operational program;*
- *Always to conduct Phase A (technical concept, feasibility) and Phase B (engineering definition) studies;*
- *To start instrument development earlier in the program; and*
- *To consider a separate contract for the instruments.*

GOES-I, now called GOES 8, was successfully launched last April and has completed on-orbit checkout. GOES-J is being readied for a May 19, 1995, launch. GOES-K flight instruments are being shipped this Spring from ITT to Space Systems/Loral for integration with the spacecraft. GOES-K will be ready for a May 1996 launch, if needed.

Question 14. What is the status of the Administration's plan to merge the duplicative polar orbiting weather satellite programs of NOAA and the Defense Department? Has the Administration settled on a final plan for convergence? Will the DOD help to defray some of the costs of the converged system, or will all costs be borne by NOAA?

Answer 14. The Departments of Commerce and Defense and the National Aeronautics and Space Administration have implemented the Administration's plan to merge the polar-orbiting environmental satellite programs of NOAA and the Defense Department in accordance with Presidential Decision Directive NSTC-2, signed in May 1994.

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Integrated Program Office (IPO) was established on October 3, 1994, under NOAA leadership. The office is staffed with a mix of personnel from the three participating agencies.

Broad organizational policies are contained in the triagency Memorandum of Agreement which has been agreed to by the Triagency Steering Committee and submitted to the respective departments for signature by the agency heads. Final approval is expected imminently. A convergence master plan (to include staffing, organizational management, acquisition strategy and baseline, etc.) will be completed within 6 months of the reporting date of the triagency-approved System Program Director.

An acquisition schedule has been developed and the IPO is currently in Phase 0 (Concept Exploration and Development) of the process. Prime contractors for this phase are Lockheed and Martin Marietta. A variety of support contractors and Federally Funded Research and Development Centers assist in this effort.

The Departments of Commerce and Defense have agreed to a funding profile over the term 1995-2000 that provides a 50/50 cost share basis for common requirements. Agency-unique requirements will be an individual agency responsibility for funding.

Question 15. Has the question of European participation in the new converged polar weather satellite system been settled? What is the status of negotiations? What are the main benefits of European participation in terms of cost and performance?

Answer 15. The European participation in the new converged polar system is still in negotiation. Currently, NOAA and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) are in the final stages of negotiating a Memorandum of Agreement for an Initial Joint Polar System (IJPS) covering cooperative efforts between now and the time of the new converged system. This IJPS will transition to the converged system in the mid 2000's when it will become the Joint Polar System (including the U.S. Department of Defense). While the IJPS agreements *have been in development for some time, they have been recently modified to accurately reflect the United States plans for convergence so that this IJPS agreement can serve as the basis for the full converged system. The IJPS agreement is projected to be finalized this summer and must then go through the governmental international agreement final approval cycle. As part of defining the architecture of the converged system, EUMETSAT has provided NOAA their requirements in a format compatible with the U.S. format, and we have invited them to participate in convergence definition activities. These technical efforts and EUMETSAT's execution of the IJPS agreement will define EUMETSAT's exact participation in the converged program. The main benefit of European participation in the U.S. polar program is the provision of a satellite in the operational constellation and the possible sharing of the development and procurement of operational sensors. Based on the convergence study completed in December 1993, the value to the converged program of the European participation is estimated to be approximately $400 million over the life of the program.*

Question 16. The Landsat satellite system provides images of the Earth that are important for global change research, land use planning, mineral exploration, and many other uses. However, the current two Landsats flying are now 8 and 13 years past their design lives and, in 1993, a replacement satellite (Landsat 6) was lost in space. The future of Landsat now depends on the development of Landsat 7, scheduled for launch in 1997. What is the status of the Landsat 7 procurement? What can you share with us about the legal controversy over extending the contract of the current Landsat contractor?

Answer 16.The Landsat Program, as defined by Congress in 1992 and modified by Presidential Decision Directive/NSTC-3 in May 1994, is managed cooperatively by NASA, NOAA and the U.S. Geological Survey (USGS). NASA will develop Landsat 7, NOAA will operate the satellite, and USGS will provide data processing and distribution on NOAA's behalf, as well as provide for the long-term archiving of the data. The Landsat 7 spacecraft is being built by Martin Marietta (now Lockheed-Martin) Astro Space. The mission instrument, the Enhanced Thematic Mapper - Plus, is a product of the Hughes Santa Barbara Research Center. Construction of both the spacecraft and the instrument are managed under contracts with the NASA Goddard Space Flight Center. The launch of Landsat 7 is currently planned for December 1998. Further inquiries concerning the status of the procurement of Landsat 7 should be directed to NASA's Office of Mission to Planet Earth.

The legal controversy over the extension of the contract with the current Landsat contract (EOSAT) deals with the issue of whether the Land Remote Sensing Policy Act of 1992 gave the Landsat Program Management (i.e., the Department of Commerce (DOC)) statutory authority to extend the current DOC/EOSAT contract for Landsat operations on a non-competitive basis. EOSAT filed an action in the U.S. District Court for the District of Columbia seeking a determination on this issue. DOC and EOSAT have filed cross-motions for a summary judgment. The court has indicated that it will issue its final ruling on June 16, 1995. Under court order, the EOSAT contract has been extended to June 30, 1995.

QUESTIONS ASKED BY SENATOR HOLLINGS AND ANSWERS THERETO BY D. JAMES BAKER

Question 1: Advanced Weather Interactive Processing System (AWIPS). The National Research Council reports that "improved information systems are critical to the National Weather Service (NWS) Modernization and restructuring" and that the key component of those systems is AWIPS. Yet despite its central importance, the schedule for AWIPS implementation continues to slip further and further behind the other components of modernization.

Question 1a: How has the recent restructuring of the AWIPS program affected program cost estimates and the original deployment schedule?

Answer: At the beginning of the development phase, the Estimate at Completion was $474 million including all contract, support, management, and related program costs through nationwide deployment. Our present estimate is $525 million. This increase is explained by extensions of the system requirements and a proposed restructuring of the contract to allow for a risk reduced schedule of incremental changes and a design system that will evolve as technology or requirements change.

The restructuring will cause the schedule for the Key Decision Point IV to enter the Deployment Phase to change from March 1996 to March 1997. The final schedule for the program will be negotiated with PRC as part of the ongoing restructure modification. We are assessing the opportunities and risks associated with accelerating the Key Decision Point IV based upon our expectation that the AWIPS hardware, communications services, operating system, and initial hydrometeorological functions will be mature and tested by October 1996.

Question 1b: What is the status of the AWIPS systems design? Will an approved system design be in place before approval of any further contract modification? If not, why not?

Answer: The AWIPS system design will be completed and presented at a final System/Subsystem Design Review in May 1995. This completes the updating of the preliminary top-level system design presented in November 1994. We expect the design to resolve the key design issues that necessitated restructuring of the AWIPS program.

The restructuring modification will not be implemented contractually until August 1995. Thus, NOAA will leave an approved design in place prior to modifying the contract with PRC. Before that time, small, interim modifications will be made to keep other critical activities on track, including risk reduction and prototyping activities.

Question 1c: what role will the Government play in the development of AWIPS software? What steps are being taken to strengthen the Government's software development processes in light of the 1994 General Accounting Office report citing inadequacies in these processes?

Answer: The Government will design, code, and document the hydrometeorological applications software. The contractor will design and develop all of the system software and resources and will integrate the Government-developed code into the final AWIPS products. This restructure change is based on a recommendation from an independent panel of Information Technology experts.

In response to the GAO report (GAO/AIMD–95–24), the responsible Government laboratories, Forecast Systems Laboratory (FSL) and Techniques Development Laboratory (TDL), have already initiated activities to strengthen their software-development processes. FSL has implemented a peer-review process for software development and has increased the overall efforts on configuration management, requirements tracking, and coordination/integration of software developed by multiple groups. TDL has instituted a nine-step software development process with checkpoints on requirements, design functionality, and documentation of code. Additionally, Government software developers will follow the overall software development plan being developed by the AWIPS contractor that includes coding and documentation standards and quality assurance.

Question 2: Accurate weather observations are essential to ensure aviation safety. We are continuing to hear concerns expressed by pilots and the aviation community that ASOS simply is not an adequate replacement for human weather observers both in terms of accuracy and dependability.

Question 2a: what is the status of ASOS commissioning temporarily halted and under what conditions will they be resumed?

Answer: ASOS commissioning was temporarily halted because of insufficient logistic support and deficiencies in a number of sensors. Since then, the outstanding deficiencies have been corrected and logistic support has been established. Consequently, at a March 21, 1995 readiness review meeting, NWS decided to resume commissioning. During the next 60 days, 10 to 20 sites are expected to be commissioned. In July, the commissioning rate will increase to the rate of 30 sites per month. Commissioning will include both NWS and Federal Aviation Administration (FAA) ASOS sites.

Question 2b: What steps are being taken by the NWS to address the wide array of user concerns that are beyond the scope of the ASOS specifications?

Answer: It is recognized that some of the industry requirements for surface weather observation data cannot be met by ASOS in its current state. NOAA is in the process of determining the best way to meet the additional requirements levied by industry. NWS, the FAA, and the aviation community are jointly involved in the ASOS Aviation Demonstration that began on February 16, 1995. One of the objectives of the demonstration is to determine the best way to meet these additional industry requirements. Concurrently, the ASOS Program is exploring enhancements to existing sensors, as well as the development of new ones in order to obtain frequently requested data that is not now provided by ASOS. For example, initial product improvement efforts are underway to develop an ASOS algorithm for sky condition during fog events, as well as improved dew point and present weather (drizzle, hail, and sleet) sensors.

Question 2a: Does the NWS plan to completely replace human observers with ASOS? If not, specify where and what types of observers (NWS, FAA, contractor, other) are to remain.

Answer: No, not in the immediate future. ASOS was never intended as the sole source of surface weather data. Pursuant to a 1988 Memorandum of Agreement with the FAA, ASOS was not designed to provide measurements that are important to aviation. It was understood that there would be continuing need to "augment" ASOS observations with human observers until the ASOS data could be supplemented by products derived from other remote automated systems, e.g., satellite cloud products, NEXRAD, and lightning data network products. Efforts to develop these additional data products are underway. ASOS observations will continue to be "augmented" by human observers, at those sites required by the aviation community, until these additional data products are available and their use is fully understood. The exact combination of NWS, FAA, and contract observers that are required in the immediate future is still being determined.

Question 3: Next Generation weather Radar (NEXRAD). I understand that the National Research Council has an ongoing study to evaluate the adequacy of NEXRAD coverage for the continental United States.

—What is the status of the study and what are NWS plans for addressing any gaps in radar coverage that the study may identify?

Answer: The study that the National Academy of sciences National Research Council (NRC) is conducting is an independent scientific assessment of proposed NEXRAD radar coverage and consolidation of field offices in terms of the "no degradation of service" requirement of Public Law 102-567. In conducting this study, the NRC will consider public comments about the NWS modernization that were received during a 60-day public comment period that closed on January 3, 1995. The NRC will also establish criteria for identifying service areas where the decommissioning of existing radars could degrade service. The NRC will document its findings and recommendations in a report to the Secretary of Commerce, which is due in May 1995.

Taking-into account public comments received, the Secretary of Commerce will then apply the NRC's criteria, plus applicable modernization criteria previously endorsed by the NRC, to the 32 areas of concern that were identified as a result of the public comments. The Secretary will identify at what locations, if any, actions to decommission a radar or to close, consolidate, relocate, or automate a field office are not likely to satisfy the "no degradation of service" requirement of Public Law 102-567. The Secretary will report the findings and recommendations, including any necessary adjustments to the NWS modernization plan to ensure no degradation of service. These recommendations will also address any gaps in radar coverage based upon the NRC study criteria. The Secretary's report will be forwarded to the Senate Committee on Commerce, Science, and Transportation and the House Committee on Science. The estimated time frame for this report is Fall 1995.

Question 4: Weather Service Modernization. What do you see as the most significant risks currently facing the NWS in its modernization program and what steps are being taken to manage those risks?

Answer: The most significant risk facing the NWS modernization is inadequate funding and FTE ceilings to complete the modernization expeditiously. The NWS is in the midst of its modernization. New offices are being staffed to receive and utilize the latest technology while older offices remain to ensure continuity of services. While some of the new technology data sources have been introduced, the essential technology to integrate that data into the forecast process, AWIPS, is yet to reach the offices.

The Strategic Plan for the NWS modernization and associated restructuring incorporates technology and staffing efficiencies based on integrated technologies. The plan addresses streamlining the NWS while maintaining the delicate balance between staffing and services. Even minor adjustments to the plan, or further delays in implementation, will impact services provided by local offices. Minor changes in the field structure could further aggravate an already skeptical public community as well as anger many Members of Congress. It is essential to maintain public confidence and reduce political issues during the phase down and closure of offices not needed in the modernized NWS.

QUESTIONS ASKED BY SENATOR DORGAN AND ANSWERS THERETO BY D. JAMES BAKER

Question 1: The NWS modernization plan for North Dakota includes placing two Doppler radars in the state: one in Mayville, North Dakota and the other in Deering, North Dakota. The plan also includes closing the Williston, North Dakota NWS office. The citizens of Williston are concerned that this plan will result in a large uncovered gap in northwestern North Dakota.

—what steps is the Department of Commerce taking to assure that comparable scientific data is being collected to assess whether or not degraded service will result in communities like Williston?

Question 2: I am told that there will be a "non-terrain" gap of coverage consisting of approximately 17,000 square miles in northwestern North Dakota.

—Is this true? If so, what led NWS to approve such a large gap on coverage and presume that the requirement of P.L. 102-567 would be met?

Question 3: I am concerned that the present plan in North Dakota will lead to a degradation of service in some parts of the state.

—If it is determined that there is a degradation of service in areas such as Williston, North Dakota, what alternatives is the NWS considering?

—Is it possible that existing facilities could be upgraded as to fill in the gap of coverage that would exist?

Answer to Questions 1–3: Because of public concerns about the adequacy of radar coverage in the modernized NWS, the Secretary of Commerce commissioned an independent study by the National Research Council (NRC) in October 1994.

On November 4, 1994, comments were requested from the public on service areas where it is believed that modernization actions taken by the NWS could degrade existing service provided by the NWS. Over 67,000 comments were received by NWS and forwarded to the NRC. The comment period closed on January 3, 1995, and a total of 32 areas of concern were identified. Williston, North Dakota was identified as an area of concern. A Federal Register notice listing these areas of concern was published on February 23, 1995.

The study that the NRC is conducting is an independent scientific assessment of proposed NEXRAD radar coverage and consolidation of field offices in terms of the "no degradation of service" requirement of Public Law 102-567. In conducting this study, the NRC will consider public comments about NWS modernization that were received. The NRC will also establish criteria for identifying service areas where the decommissioning of existing radars could degrade service. The NRC will document its findings and recommendations in a report to the Secretary of Commerce, which is due in May 1995.

Taking into account public comments received, the Secretary of Commerce will then apply the NRC's criteria, plus applicable modernization criteria previously endorsed by the NRC, to the 32 areas of concern that were identified as a result of the public comments. The Secretary will identify at what locations, if any, actions to decommission a radar or to close, consolidate, relocate, or automate a field office are not likely to satisfy the "no degradation of service" requirement of Public Law 102-567. The Secretary will report the findings and recommendations, including any necessary adjustments to the NWS modernization plan, to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science of the House of Representatives. The estimated time frame for this report is Fall 1995.

Even after the study and report have been completed, the Secretary must still certify "no degradation of service" before NWS offices can be closed, consolidated, relocated, or automated.

Questions 4: It is my understanding that Williston has filed with the NWS as an "area of concern," asking to be reviewed.

—Can you tell me the current status of the Williston NWS office? Is the Williston site scheduled for closure? Or is it's scheduled closure on hold, pending a review?

Answer: The current NWS modernization plan targets the Williston Weather Service Office for closure. However, actions to phase down the Williston office are on hold pending the outcome of the NRC study and the Secretary's report to Congress.

Question 5: It is my understanding that a NWS office in Huntsville, Alabama has been upgraded but NWS has refused to commission it. The purpose of my raising the issue of this site here is that I understand that the Huntsville site is capable of providing comparative data with a neighboring NEXRAD site.

—what is the status of the Huntsville radar? Could you provide me with more information on this radar?

Answer: The Huntsville, Alabama, Weather Service Office has a local-use WSR-74C radar that is commissioned and operational.

The radar is equipped with an Enterprise Electronics Corporation doppler add-on capability that is not official NWS equipment and, therefore, cannot be commissioned.

Huntsville was one of the 32 areas of concern identified through the recent public-comment period (see answer to questions 1-3). The local-use radar at Huntsville will not be decommissioned until some time after the results of the NRC study and the Secretary's report to Congress. With respect to comparative data, the NEXRAD WSR-88D radar is far superior to the Enterprise doppler both in terms of severe storm detection capability and data reliability.

Questions 6: Some budget cutters have talked about repealing the 1992 certification requirement as a cost-saving measure that could be included in a rescission bill.

Is the NWS, the White House, or anyone else in the Administration advocating the repeal of the 1992 Weather Service Modernization Act requirement that the NWS must certify that there will be no degradation of service before any of it's offices are closed, consolidated, relocated, or automated?

Answer: The Administration is not advocating full repeal of Title VII of Public Law 102-567, the Weather Service Modernization Act. As part of the Vice President's National Performance Review and the Reinventing Government initiative, the Administration is looking at ways to streamline the certification process to reduce unnecessary costs. We are currently reviewing different options and expect to have a recommendation to forward to the Vice President for review shortly. Examples of possible streamlining measures include: (1) elimination of the current requirement that each certification be published for a 60-day comment period and (2) elimination of the mandatory requirement for liaison officers in every service area.

In summary, the effect of streamlining the transition process would be to reduce costs in fiscal year 1996 and beyond. This reduction would result from significantly shortening the time between when the NWS can assure no degradation from an operational standpoint, and when the Secretary actually transmits the certification to Congress.

QUESTIONS ASKED BY SENATOR KERRY AND ANSWERS THERETO BY D. JAMES BAKER

Question 1: Global Warming. On Friday, January 27, 1995, a front page article in the New York Times carried the headline, "Global Warming Resumed in 1994, Climate Data Show". The article cites National Weather Service data showing that global temperatures from March through December were the warmest on record.

From the public and policy standpoints, what does this evidence really show us? Are we seeing greenhouse warming, the end of the cooling effects of Mt. Pinatubo, a seasonal shift due to El Niño, or what?

Are the agencies working cooperatively and what specific actions are being taken to ensure interagency cooperation?

Answer: The resumption of near record warm global mean temperatures over the past year is related to a variety of causes including the removal of stratospheric aerosol particles emitted from the eruptions of Mount Pinatubo and, to a lesser extent, Mount Hudson in 1991. El Niño-Southern Oscillation (ENSO) events influence climate, especially regionally, over short periods of a few years. Such recent events have created short-term anomalies in longer term temperature trends. Scientists must examine longer-term trends, say over the past several decades, to see whether the climate is changing due to anthropogenic causes such as an enhanced and/or accelerated greenhouse effect. To date, the best-mechanism for building a scientific consensus useful for policy purposes is the Intergovernmental Panel on Climate Change (IPCC). The last full assessment was made in 1990 with interim assessments in 1992 and 1994. Another full assessment is presently being completed for the latter part of 1995. Until that assessment is released, the following is a synopsis of our degree of understanding of issues related to the greenhouse effect that is based, primarily, on those assessments:

What Scientists Understand Very Well:

- Greenhouse Gases Absorb Infrared Radiation. Greenhouse gases absorb and reradiate infrared radiation at wavelengths characteristic of the Earth's temperatures, altering the atmospheric radiative balance. The greenhouse effect is a natural part of the planetary system. Water vapor and carbon dioxide have been part of our atmosphere for hundreds of millions of years and their presence has produced an average surface temperature of ~15° C (60° F). Without them, the average surface temperature would be around −15° C (5° F). Independent of other factors, increasing abundances of greenhouse gases produce additional heating of the Earth system. Uncertainties arise as to how various climatic processes respond to the increased heating.
- The Atmospheric Abundances of Greenhouse Gases are Increasing Due to Human Activities. There is essentially no doubt that the atmospheric abundances of carbon dioxide (from combustion of fossil fuels, changes in land-use practices, cement production), methane (landfills; exploitation of coal, oil and natural gas; cattle and rice), nitrous oxide (fertilizers and nitric acid production) chlorofluorocarbons (refrigerants, solvents, foam-blowing agents), hydrofluorocarbons (substitutes for chlorofluorocarbons), and fully fluorinated chemicals (aluminum industry) are significantly greater than in the pre-industrial era due to human activities.

- Greenhouse Gases Affect the Earth's Climate for Centuries. The changes in the Earth's climate in response to enhanced atmospheric abundances of greenhouse gases, cannot be reversed for many centuries because of the very long residence times of most greenhouse gases (carbon dioxide, nitrous oxide, and chlorofluorocarbons), and the associated time response of the climate system. For example, the residence time for carbon dioxide is around 150 years and the perfluorocarbons have residence times in the thousands of years depending on species.
- Changes in Other Substances Partially Offset the Impact of Greenhouse Gases. Decreases in lower stratospheric ozone and increases in sulfate and carbonaceous aerosols act to produce a cooling effect near the Earth's surface. The quantitative regional and global impact of these decreases in net heating are rather uncertain. Depletion of stratospheric ozone and the increase in aerosols may have partially offset the predicted global warming to date, particularly in the northern hemisphere. However, their long term effects are thought to be small relative to the predicted effects of increases in greenhouse gases, particularly carbon dioxide, because lower stratospheric ozone abundances are expected to start to increase after the year 2000 in response to an elimination of halocarbon emissions and because global concentrations of aerosols are predicted to grow less rapidly than carbon dioxide. The atmospheric lifetimes for aerosols and their precursors are very short (days to weeks) in contrast to the very long lifetimes (decades to centuries) of the key greenhouse gases. Therefore, their radiative effects on global warming rapidly adjusts to increases or decreases in emissions.
- Natural Climate Variability Makes it Difficult to Detect an Enhanced Greenhouse Warming. Because climate varies naturally on time scales of months to centuries, any human-induced climate change must be interpreted in the context of such natural variability. While the predicted magnitude of the greenhouse warming to date is not significantly greater than natural decadal variability (approx. ±1° C), the predicted change over the next few decades is likely larger than natural variability.
- Global Surface Temperatures Have Increased Over the Past Century. In spite of the limitations in the climate record (an inadequate number of continuous, calibrated observations with proper geographic coverage), there is almost no doubt that the global mean surface temperature has increased between 0.3 and 0.6° C (0.5 to 1.0° F) over the past century. The observed warming over parts of the northern-hemisphere, mid-latitude continents, has been found to be largely characterized by increases in minimum (night-time) rather than maximum (day-time) temperatures. Scientists cannot yet say what fraction of this warming trend arises from the greenhouse effect.
- Global Surface Temperatures have been Anomalously High in Recent Years. Global mean surface temperatures were anomalously high (highest on record) in the late 1980's and 1990 and 1991. The volcanic eruption of Mount Pinatubo in 1991 resulted in a transitory warming of the stratosphere and a cooling of the troposphere.
- No Inconsistency is Found Between Radiosonde and Satellite Observations of Temperature Trends. Radiosonde (weather balloon) data indicate that the lower troposphere has warmed over recent decades. since meaningful trends cannot be assessed over periods as short as a decade, publicized disagreements between 1980's trends of air temperatures from satellites and radiosonde data cannot be confirmed because the trends are statistically indistinguishable.
- Substantial Reduction of Key Uncertainties Needs a Decade or More. While much is already known about the greenhouse effect, very important uncertainties remain in the quantification of timing, magnitude and regional patterns of climate change. Accurate predictions of the magnitude and timing of climate change are limited by our knowledge of the role of clouds and water vapor and the role of the oceans, respectively.
- The Stratosphere is Expected to Cool significantly. Halocarbon-induced (chlorine and bromine) ozone decreases in the upper stratosphere will lead to reduced absorption of solar radiation, thus less heating, while increased concentrations of carbon dioxide will increase radiative heat loss in the upper stratosphere. These two effects could lead to temperature decreases of 8-20° C. Also, polar ozone losses over the past decade have already produced a cooling of about 1° C in the high latitude lower stratosphere.

What Scientists Understand Reasonably Well:

- Observed Global Temperature Changes are not Inconsistent with Model Predictions. The size of the observed warming is broadly consistent with the predictions of climate models, but is also the same magnitude as natural climate variability. Alternatively, natural variability and other human factors (ozone depletion and aerosols) could have offset a still larger human-induced greenhouse warming. The consistency between observations of global mean temperature trends over the past century and model simulations of the warming due to greenhouse gases over the same period is reasonable if allowance is made for the increasing evidence of a relative cooling effect due to anthropogenic aerosols (from sulfur emissions and biomass burning) and stratospheric ozone depletion.

- Doubled Carbon Dioxide Abundances are Predicted to Lead to Significant Temperature Increases. Modeling studies, observations, and sensitivity studies-suggest that the warming of global mean surface temperature due to a doubling of carbon dioxide is unlikely to lie outside the range 1.5 to 4.5 °C.
- Significant Warming is Expected by the Mid-21st Century. A global mean surface warming of 1-3° C is predicted to occur in the middle of the next century, assuming that the global emissions of greenhouse gases continue at the levels of the central IPCC scenarios (1990 or 1992). The warming over the next century will depend on the rate of growth of greenhouse gas and aerosol concentrations, natural fluctuations in the climate system, and the detailed response of the climate system (in particular clouds and the slowly changing components, i.e., oceans and glacial ice). Based on historical records, ocean delay, effects of aerosols, and recent cloud radiation studies, the magnitude of the global warming is more likely to be in the lower half of this range.
- Sea Level is Expected to Rise for Many Centuries. Thermal expansion of sea water is expected to increase sea level by 4 to 12 inches by the end of the next century (corresponding to a temperature increase of 1-3° C). Additional contributions are expected from the melting of land ice over many centuries. Hence sea level rise can become very large.
- Greater Warming is Likely in Northern Polar Winter. Greater winter surface warming is predicted in northern polar regions as the sea-ice boundary shifts northward. Observing this predicted effect may be more difficult because of the larger natural climate variability of this region.
- Reductions in Northern, but not Southern, Sea Ice are Expected. Models calculate a total sea ice reduction in high latitudes of the northern hemisphere as the climate warms. However, no such decrease is expected in sea ice in the high latitudes of the southern hemisphere over the next century. This is because of the initial resistance to climate change caused by the rapid exchange of heat between the atmosphere and the deep ocean around Antarctica.
- Global Mean Precipitation will Increase: Changes in Regional Distribution are Less Certain. The rate of evaporation should increase as the climate warms, leading to an increase in global mean precipitation. Some regions will experience increases in precipitation, while others will experience a decrease. Increased evaporation should lead to higher atmospheric water vapor concentrations. As the climate warms, the increased poleward penetration of warmer, moist air will likely increase the annual-averaged precipitation at high latitudes.
- Climate Change Will Impact Ecological and Socio-Economic Systems. Climate change will have consequences for agriculture and forestry, natural terrestrial ecosystems, hydrology and water resources, human settlements, human health, air quality, oceans and coastal zones (sea level rise), and the energy, transport, and industrial sectors. The most significant potential impacts of climate change are likely to include changes in regional patterns of precipitation and soil moisture, leading to changes in water availability, agricultural productivity, and shifts in the productivity and boundaries versus natural terrestrial ecosystems.

What Greenhouse Predictions are Less Certain:

- Mid-Continental Summer Dryness is Predicted. Several models predict an earlier onset of the normal spring-summer reduction of soil moisture, causing a marked decrease in soil moisture over some mid-latitude continental regions during summer. This predicted drying is caused by increased evaporation as well as early termination of snow melt and rainy periods. Significant uncertainties regarding land surface processes preclude high confidence in these predictions.
- Ocean Overturning is Predicted to Diminish. The predicted increase in precipitation at high latitudes and run-off reduces the salinity and hence the density, in high-latitude oceans. This reduced density slows down the tendency for water to sink at high latitudes, causing significant implications for the uptake and release of carbon dioxide and heat. Substantial climate warming associated with high concentrations of carbon dioxide can, in theory, almost completely shut down the overturning circulation. This could have major impacts which have yet to be explored.

The Most Serious Uncertainties That Need to be Resolved:

- Regional Scale Predictions of Climate Change Remain Uncertain. Regional-scale model predictions are uncertain because current models do not yet have the appropriate spatial resolution, and they inadequately represent land-atmosphere interaction processes.

- Cloud Radiation Feedbacks Remain Uncertain. The single largest uncertainty in determining the magnitude of climate change for a given increase in greenhouse gas concentrations is the response of clouds and water vapor. Increased cloudiness in the upper troposphere can amplify the warming, while increased cloudiness in the lower troposphere can suppress the warming.
- Changes in the Frequency and Intensity of Tropical Storms are Still Uncertain. Simplified models suggest that a warmer, wetter atmosphere would lead to an increase in the frequency and intensity of tropical storms. However, factors such as regional wind structure, which govern tropical storm formation, are not well represented in present models.
- Future Atmospheric Abundances of Carbon Dioxide Depend upon several Factors. Future atmospheric abundances of carbon dioxide are critically dependent upon uncertain details of the carbon budget (uptake and release of carbon between the atmosphere and the oceans and between the atmosphere and the terrestrial biosphere) and anthropogenic emissions, which depend upon factors such as population, economic growth, technology development, energy availability and prices. The role of other greenhouse gases, such as tropospheric ozone, also needs to be clarified.

Question 2: Environmental technologies. What is the status today of on-going conversations among the Commerce Department, the Environmental protection Agency and other agencies to help industry develop new next-generation environmental technologies?

Are the agencies working cooperatively and what specific actions are being taken to ensure interagency cooperation?

The Department of Commerce works closely with other agencies to encourage both the development and export of environmental technologies. The two go together—U.S. business needs support and assistance to reach the growing international markets for environmental technologies, while our ability to compete and win in international markets depends on being technological leaders.

Major inter-agency initiatives include the Rapid Commercialization Initiative, and the Environmental Technologies Export Strategy of the Trade Promotion Coordinating Committee.

The Rapid Commercialization Initiative (RCI)—announced by the Vice-President this December—provides the coordination, impetus, and infrastructure so that Federal resources do their part to accelerate the commercialization of innovative environmental technologies. It does this by:

- First, focusing Federal actions on overcoming barriers that slow commercialization for needed environmental technologies. These actions include:

1. Increasing availability of testing sites and experimental permits. Offering more test sites—including Federal sites—and encouraging the availability of permits for testing will allow developers to bring their technologies to market more easily.
2. Verifying the performance of innovative technologies so that federal, state and local regulators—and the market place—can readily assess their efficacy.
3. Providing credible performance information to assist decision makers with new technology use permits.
4. Facilitating the diffusion of these technologies.

Each of these components acts in concert as part of a larger formula for reducing the barriers to the rapid innovation, development and commercialization of environmental technologies.

- Second, applying this learning to mitigate key barriers to commercialization. Beyond directly supporting the rapid commercialization of selected technologies, the ultimate goal of the RCI is to systematically reduce the institutional, policy, and statutory barriers—including regulatory and liability issues—that impede innovation and commercialization of new environmental solutions.

Agencies participating in RCI include the Environmental Protection Agency-and the Departments of Commerce, Defense, and Energy. The Initiative will be coordinated by Commerce through the Inter-Agency Environmental Technologies Office.

The Department of Commerce sponsored a roundtable discussion with industry in late March in order to obtain detailed industry views on the structuring of RCI. A Notice of Public Intent describing RCI is planned for publication in the Federal Register this summer.

The other component to promoting environmental technology development is effective support for exports to the growing international markets. In response to the President's call for the formulation of a strategy to promote the competitiveness of the U.S. environmental technology industry, the Administration released Environmental Technologies Exports: Strategic Framework for U.S. Leadership.

Under the leadership of Secretary Brown the 19 agency Trade Promotion Coordinating Committee (TPCC) is implementing the export strategy by taking the lead in coordinating federal environmental export programs. Last March, the ITA established the Office of Environmental Technologies Exports. The TPCC Environmental Trade Working Group is co-chaired by the Department of Commerce and the Environmental Protection Agency.

- The export strategy rests on strong public/private partnerships. The 35-member Environmental Technologies Trade Advisory Committee was created in December 1994 to strengthen the direct link between the Federal government and the environmental technology private sector.

Among the coordinated actions called for in the export strategy, the Department has implemented an aggressive advocacy program, continues to participate in vital trade negotiations, and has most recently targeted high-growth export markets for environmental technologies.

In cooperation with other key agencies, the Department produced five export market plans to help U.S. companies evaluate and access environmental markets in Mexico, Chile, Argentina, the China Economic Area (China, Hong Kong, and Taiwan), South Korea, Poland and the Czech Republic. Additional export market plans for Brazil, India, and Turkey will be released in the immediate future.

Question 3: NOAA budget priorities. Dr. Baker, you and I have talked at some length about putting the "O" back in NOAA. Now you're proposing that NOAA take the lead on a $5 billion interagency weather satellite program, and I understand that NOAA would like to get involved with Landsat again as well.

How do you justify these proposals in light of NOAA's existing budget constraints and the need to maintain our investment in ocean and coastal programs?

Answer: We have constructed a budget that balances the requirements of our multiple missions, and meets Administration priorities. Our investment in coastal and ocean programs remains robust and is improving in several areas.

Harnessing the power of remote sensing satellite technology for application to ocean and coastal resource management is an essential and efficient way to invest NOAA resources. Integrating information on larger scale phenomena such as broad changes in sea surface temperature and regional land-use patterns is an important part of NOAA's efforts to provide the information necessary to manage the Nation's coastal and ocean resources.

In fiscal year 1995, we have taken an aggressive three-pronged approach to ocean remote sensing: (l) continuation of the operation and use of the ocean sensing capability of the operational NOAA satellites; (2) developing a capability to exploit non-NOAA ocean satellites for NOAA applications; and (3) beginning to explore options for ocean sensing capabilities on the converged civil/military polar-orbiting operational environmental satellites.

Although vital for meteorological services, the National Polar Orbiting Environmental Satellite System (NPOESS) will serve a multidisciplinary mission including and expanding on products to the oceanographic and coastal communities. This includes the production of sea surface temperature and sea ice maps, as well as information on unusual ocean events such as toxic phytoplankton blooms through the CoastWatch program. Funding is requested this year to develop a new suite of oceanographic products including ocean color, wave and sea surface heights, and sea surface winds with data acquired from non-NOAA oceanographic satellites.

This is also an efficient way to proceed. Our involvement in the NPOESS will result in the elimination of redundant satellite systems which would have been built by the USAF and NOAA following completion of the current systems. This major achievement of reinventing government will save the taxpayers up to $300 million by 1999 when compared with the cost of the USAF and NOAA each purchasing independent satellite systems. We are also evaluating what appears to be a promising capability for continuous sea-surface observations by NOAA's new Geostationary Operational Environmental Satellite.

Similarly, NOAA, as the Federal civil operator of environmental satellites, is following Administration directives in taking on responsibility for the operation of the next generation of land remote sensing satellites, a national asset being developed mainly at NASA expense. Landsat data serves the needs of users in multiple disciplines, including coastal programs through its land use maps, documentation of sedimentation and runoff, and mapping of aquatic vegetation.

We have requested increases in the Sea Grant, Coastal Zone Management, Estuarine and Coastal Assessment, National Marine Sanctuary, Coastal Ocean Science, and non-point source pollution programs. New funding is requested for regional ecosystem studies to allow ecosystem management in coastal areas. The Coral Reef Initiative is one example of new efforts focusing on some of our most fragile coastal habitats. These increases, coupled with base expenditures in excess of $500 million for coastal and ocean programs, demonstrate the priority we attach to the 'O' in NOAA.

NOAA has also requested an increase of $51 million in the President's fiscal year 1996 budget for the National Marine Fisheries Service. This funding will help to build sustainable fisheries and recover protected species through improved information on the status of marine resources, the development of management and conservation plans for protected resources, and the implementation of controlled access fishery management programs.

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